A window open on the world

The UNESCO Courier

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ONLY ONE EARTH

TREASURES OF WORLD ART

73 IRAN

Geometry of abstraction, 2000 B.C.

Masterwork of abstraction, this Persian female deity (20 cm., 8 in. high) carved in stone some 4,000 years ago, was unearthed at Tepe Hissar in northwest Iran, near the Caspian Sea. Reducing the human form to its simplest expression, with two triangles representing body and limbs, topped by a cylinder-shaped head, the sculptor has produced a geometric-shaped figure whose pure forms and lines are strikingly modern. Tepe Hissar (tepe means mound or hillock) is one of many ancient sites where archaeologists have made rich discoveries of pottery, vases of stone and metal, jewellery and figurines dating from the Bronze Age.

Photo © Teheran Museum, from " L'Art Iranien ", Bibliothèque des Arts, Paris, 1971

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Drawing © Mary Robertson, Clear Creek, San Francisco, U.S.A.

ONLY ONE EARTH

Proud of his technological mastery and eager to grasp its benefits, man has been burning the candle at both ends and despoiling the biosphere on which his existence depends. Careless technology has polluted the oceans, land and atmosphere to such an extent that the quality of life is rapidly depreciating. At the United Nations Conference on the Human Environment, held in Stockholm last summer, the nations of the world took the first tentative steps towards resolving the problem of safeguarding our planet while at the same time ensuring an improvement in the standard of life for the developing countries.

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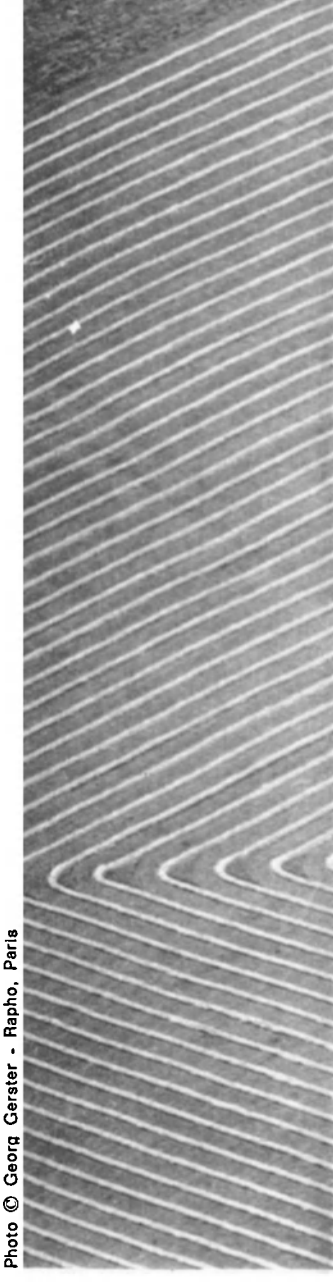

Photo © Georg Gerster - Rapho, Paris

No nation can as yet claim true expertise in environmental management. The so-called developed nations are only a few years ahead of the developing states in awareness and experience. Here, a highly advanced Argentinian farmer, near the city of Rosario, steers his harvester round a clump of trees in the centre of his beautifully worked field.

A world policy for the environment

by Lynton K. Caldwell

THE basic concept of world environmental policy and decision-making is now the *biosphere*. This term, and the idea it expresses, is scarcely more than a century old. Its development has been truly international. Its origins have been traced to the French naturalist, Lamarck; the term first appeared (1875) in the scientific writings of the Austrian geographer, Suess; and its full development and entry into the lexicon of modern science was largely the work of the Russian mineralogist, V.I. Vernadsky.

Scientific recognition of the practical significance of the complex unity of the biosphere preceded, by several decades, a comparable political awareness. Not until the Paris Biosphere Conference of 1968, sponsored by Unesco (in co-operation with the United Nations, the World Health Organization, the Food and Agriculture Organization, the International Union for Conservation of Nature and Natural Resources, and the International Biological Programme of the International Council of Scientific Unions) did the world environment, as biosphere, appear upon the agenda of official representatives of nations and international organizations.

United Nations conferences in 1949 (Conservation and Utilization of Resources) and 1963 (Application of Science and Technology for the Benefit of Less Developed Areas) may have tacitly assumed the oneness of the planet Earth. But they did not examine the implications of this complex unity for man-environment relationships. The behaviour of peoples and governments toward the biosphere was left largely unexplored until 1968.

As often happens in public affairs, non-governmental action preceded official political recognition. In 1948, at Fontainebleau (France) with the assistance of Unesco, the International Union for Conservation of Nature (IUCN) was established. The Union has now become the world conservation organization, its name extended to include Natural Resources, and its functions enlarged to environmental policy, law, and administration.

More recently (1970), the International Council of Scientific Unions (ICSU) established its Scientific Committee on Problems of the Environment (SCOPE). As with IUCN, SCOPE has found that its primarily scientific mission cannot be adequately performed without considering the human impact upon the environment.

This impact, however, results not only from the activities of human individuals; it is widely organized and mediated through governments, corporations, and international organizations. Even to analyze and describe the interactions of man with the environment requires inputs from social and behavioural disciplines not fully represented among the scientific bodies forming ICSU.

In microcosm this need to integrate all relevant sciences and professional

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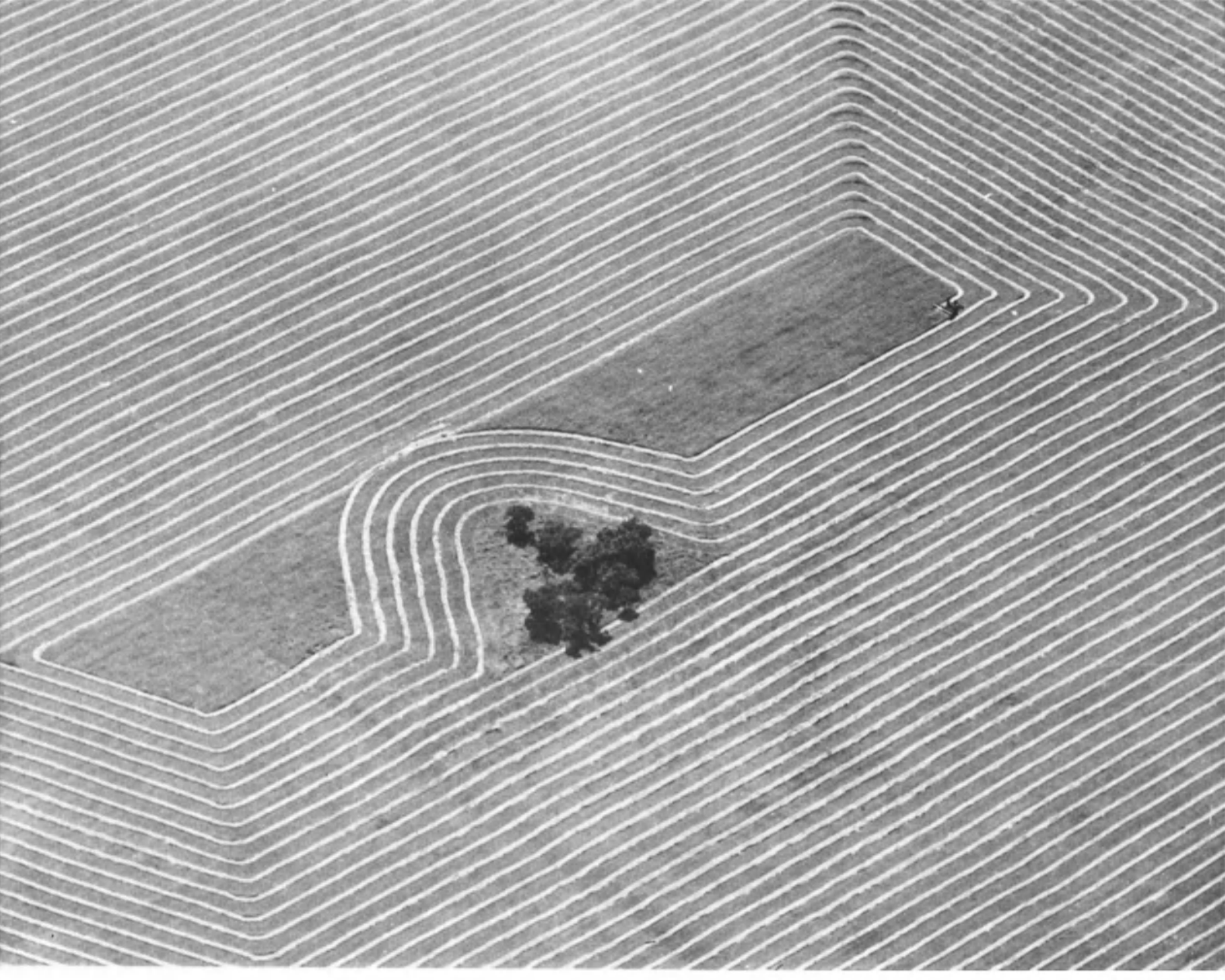

skills in analyzing the environmental decision process reflects the larger problem of governments and international organizations in coping with complex environmental questions to which no single discipline can provide an adequate answer.

If the Biosphere Conference of 1968 marked the arrival of international political awareness of the world environment, the United Nations Conference on the Human Environment, meeting in Stockholm in June 1972, provided confirmation of this awareness.

The Biosphere Conference was technically an assembly of scientific experts, whereas the United Nations Conference was a meeting of political representatives of governments. Representatives of more than 110 nations were present at Stockholm and adopted an Action Plan of 109 recommendations to national government and international organizations. The Conference also adopted a declaration, and proposed new U.N. machinery to assist the translation of the work of the Conference into scientific and political action.

To facilitate this task the Conference urged establishment of a World Environment Fund, made up of the voluntary contributions of national governments. Support for the Fund has already been pledged by a number of states, including Canada, the German Federal Republic, Iran, Japan, Sweden, the Netherlands, and the United States.

Disposition of the Stockholm recommendations rests, of course, with the General Assembly of the U.N., with national governments, and with the U.N. Specialized Agencies. Implementation of the Action Plan cannot be accomplished overnight, but there are good reasons for believing that most of it will ultimately be put into effect. Even without official endorsement, many of the recommendations may influence and guide the environmental decisions of governmental and international officials.

Support for guarded optimism may be found in action taken by national governments to cope with their environmental problems. As late as 1968, no country was organized politically or administratively to deal with "environment" as such. Decisions affecting man-environment interactions were made pursuant to other considerations, such as public health, economic policy, tourism, national security, or preservation of a national heritage.

The analogy of the biosphere as the planetary life-support system achieved popular comprehension as a consequence of the voyages into outer space by Americans and Soviets (the Spaceship Earth concept); the vision of the lonely blue planet viewed by the astronauts and cosmonauts had a profound psychological impact upon the peoples of the Earth.

No event in historic time has dramatized more powerfully the unity and fragility of the biosphere. The symbol of "only one earth" transcended languages and ideologies; its message readable even by the illiterate. And while it would be difficult to demonstrate that the lunar voyages directly influenced specific environmental decisions, they clearly affected the climate of thought and opinion in which action was taken by governments and international organizations after 1968.

Between 1969 and 1972, nearly every industrialized nation took legislative or administrative action to cope more effectively with its environmental problems. A landmark in national legislation was the signing on January 1, 1970 by the President of the United

CONTINUED NEXT PAGE

States of the National Environmental Policy Act of 1969. This far-reaching law established criteria to guide the decisions of agencies of the United States Government that had a significant impact upon the environment.

The Act contains a novel method of enforcement. For any action by any federal agency having a significant environmental impact, a responsible official must prepare a five-point statement explaining, and justifying, the action proposed. These statements have been made subject to review by the high-level Council on Environmental Quality (also established by the Act) and are made available to state governments, to other federal agencies, and to the concerned public.

In 1970, the United Kingdom provided, in a White Paper on Protection of the Environment, a basis for governmental reorganization leading to establishment of the Department of the Environment. In 1971, the French Government established a Ministry for the Protection of Nature and the Environment. In Sweden, Canada, Japan, and many other countries, new environmental agencies were created, or existing departments and ministries were reorganized.

The world-wide impact of environmental concepts upon governmental organization was evident in the reports submitted by as many as 80 countries to the Preparatory Committee for the United Nations Conference on the Human Environment.

Prior to the U.N. Conference, and at the plenary sessions at Stockholm, representatives of national governments issued formal declarations regarding the environmental policies of their nations. A collection of these statements has been assembled for publication by the IUCN, and they indicate a widespread commitment by heads of state and high-ranking officials to the objectives of environmental improvement and protection.

A major task in institutionalizing national decisions on environmental issues is to find ways to reconcile ecology and economics. National development goals and policies, regarding the applications of science and technology, have often been formulated without adequate regard to their ecological consequences.

In the past, the political and administrative structures, through which decisions were taken, handicapped and often precluded, co-ordination and reconciliation of environmental and developmental policies. In pursuit of development goals serious ecological errors have been made in many countries, leading too often to disappointing failures of development and to waste of scarce resources.

There has been recently published a 1,060 page volume of case studies and analyses by 70 internationally-known scientists examining development projects that were unsuccessful or that produced destructive side-effects because of failure to reconcile technology with ecological realities and development goals: (The Careless Technology: Ecology and International Development. Edited by M.T. Farvar and J.P. Milton, Natural History Press, 1972).

Photo Alain Nogués © Gamma, Paris

In nearly all of the more than 50 cases reported, the miscarriage of development may be explained by inadequacies in the structuring of decision-making. At policy formulating levels there was seldom adequate means for obtaining a full input of relevant scientific data, for identifying alternate means to development goals, or for testing the probable outcomes of these alternatives.

Moreover, institutional machinery for project execution seldom was provided with guidelines, check points, and periodic reassessments of technical procedures that could enable projects to be redirected when self-defeating or when dysfunctional effects appeared.

It is not always easy to discover exactly where and how the structure of decision-making has led to undesired results. The actual mechanisms of decision in governmental and international agencies are seldom fully open to public scrutiny or to behavioural research. Private corporate decisions are usually even less amenable to investigation. And yet the widespread current tendency of governments to reorganize for environmental management indicates that there is a recognized desire for structural improvement.

Many of the U.N. Specialized Agencies have established environmental offices or co-ordinative arrangements for environmental affairs; and the Stockholm Conference (as previously noted) recommended the establishment of an environmental office in the United Nations Secretariat. The Economic and Financial Committee of the U.N. General Assembly recently

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Photo © Nils-Johan Norenlind, Stockholm

Photoa © Saftra, Stockholm

The bicycles of Stockholm

Last summer, Stockholm was the scene of an international meeting of vital concern to all peoples and governments—the U.N. Conference on the Human Environment. In photo left, U.N. Secretary-General, Kurt Waldheim, is dwarfed by the giant emblem symbolizing man and the biosphere, as he opens the first meeting. Many thousands of yóung people from virtually every country congregated in Stockholm at the time (photos above), and at the U.N. conference, as well as at independent Environment Forums and spontaneous gatherings, gave voice (and music) to their views and feelings about pollution, war, overpopulation and other environmental questions. Delegates scorned autos and other polluting transport and took to bicycles instead. Photo below, General Secretary of the U.N. meeting Maurice Strong (second from left) leads a group of delegates through the streets of Stockholm.

Photo © Pressens Bild AB, Stockholm

Study of the biosphere has led us to take a new look at the interaction of man with his planet. Right, "The False Mirror", by the Belgian surrealist artist René Magritte (1928). "We are", says Barbara Ward, "the generation to see through the eyes of the astronauts the astonishing 'earthrise' of our small and beautiful planet above the barren horizons of the moon".

ONLY ONE EARTH

by Barbara Ward

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I cannot help wondering whether we may not be present at one of those turning points in man's affairs when the human race begins to see itself and its concerns from a new angle of vision and, as a result, finds new openings for action, for courage and for hope.

I cannot help wondering whether today's debates on the human environment, in their passion, scale and originality, do not resemble the profound questionings of the accepted order which erupt into human history in times of radical change.

One thinks of the intellectual ferment which, over two millenia ago, accompanied the end of China's feudal wars and the establishment of the first great centralized Han dynasty. In more recent history men had almost to stand on their heads to realize that the sun did not go round the earth, but the reverse. This "Copernican Revolution" is the archetype of fundamental change by which men learn to rethink, totally, their place in the scheme of things.

Our own epoch is, I believe, such an age again. We belong to the generation that has used radio telescopes to uncover 100,000 million other galaxies each with 100,000 million other suns. We belong to the generation that has brought nuclear energy to earth, made possible by computers the simulation, acceleration and forward projection of infinitely complicated human activities and provided us with instantaneous worldwide and interplanetary visible and audible communication.

Above all, we are the generation to see through the eyes of the astronauts the astonishing "earthrise" of our small and beautiful planet above the barren horizons of the moon. Indeed, we in this generation would be some kind of psychological monstrosity if this were *not* an age of intense, passionate, committed debate and search.

So vast is the scale of change through which we live that there must be an equally vast range of competitors for first place as agents of upheaval. I wish to suggest three areas in which the concepts that are being virtually forced upon us offer a startling break from past patterns of thought and accepted wisdom.

● The first is the possibility of making the planet unfit for life. Hitherto, people have known that they could do local damage. They could farm carelessly and lose top soil or deforest or overgraze or mine out a mineral. They also contrived to live through major natural disasters—earthquakes, tornadoes, ice ages. But nobody thought that the planet itself could be at risk.

Today our experts know something new. They know that air, soil and water form a totally interdependent worldwide system or biosphere sustaining all life, transmitting all energy and in spite of its rugged powers of survival, full or inmensely delicate and vulnerable mechanisms, leaves, bacteria, plankton, catalysts, levels of dissolved oxygen, thermal balances—which alone permit the sun's searing energies to be transmuted and life to carry on.

Our experts also tell us what we do *not* know. Given our suddenly and vastly increasing numbers, our enormous rise in the use of energy, including nuclear energy, and our fabulous mastery of molecular chemistry, we impinge on the fine balances and mechanisms of the total system in ways and with consequences that we too often are in no position to judge.

Let me give one example. Our traditional vision of the oceans is boundless. It is inconceivable to our imagination that we should permanently damage this infinity of water. But we have *no* idea of its capacity to absorb—as it ultimately must—virtually *all* the planet's wastes.

In the last two or three decades, to give only one instance, a high percentage of the long-lived chlorinated hydrocarbons—including DDT—appear to have been absorbed into natural "sinks" in the biosphere. Recent sample-taking suggests an unexpectedly high dosage appearing in the oceans.

Does this mean that natural storage systems are filling up? Will further effluents reinforce irreversible damage to marine species known to be susceptible to such substances as DDT? Is this part of a deeper risk of deterioration from a steadily widening range of chemical wastes? We do not know.

Rivers and lakes teach us that there are limits to water's self-cleansing

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BARBARA WARD (Lady Jackson), *well-known British economist and writer, is co-author (with René Dubos) of "Only One Earth", written specially for the U.N. Conference on the Human Environment (details page 33). Her other books include "The Rich Nations and the Poor Nations" (1962), "Spaceship Earth" (1966), and "An Urban Planet" (1971). Barbara Ward is at present Schweitzer Professor of International Economic Development at Columbia University, In New York. The full text of the article presented here will shortly be published by W.W. Norton (New York) In a collection of papers of the Distinguished Lecture Series at Stockholm, 1972, sponsored by the International Institute of Environmental Affairs and the Population Institute.*

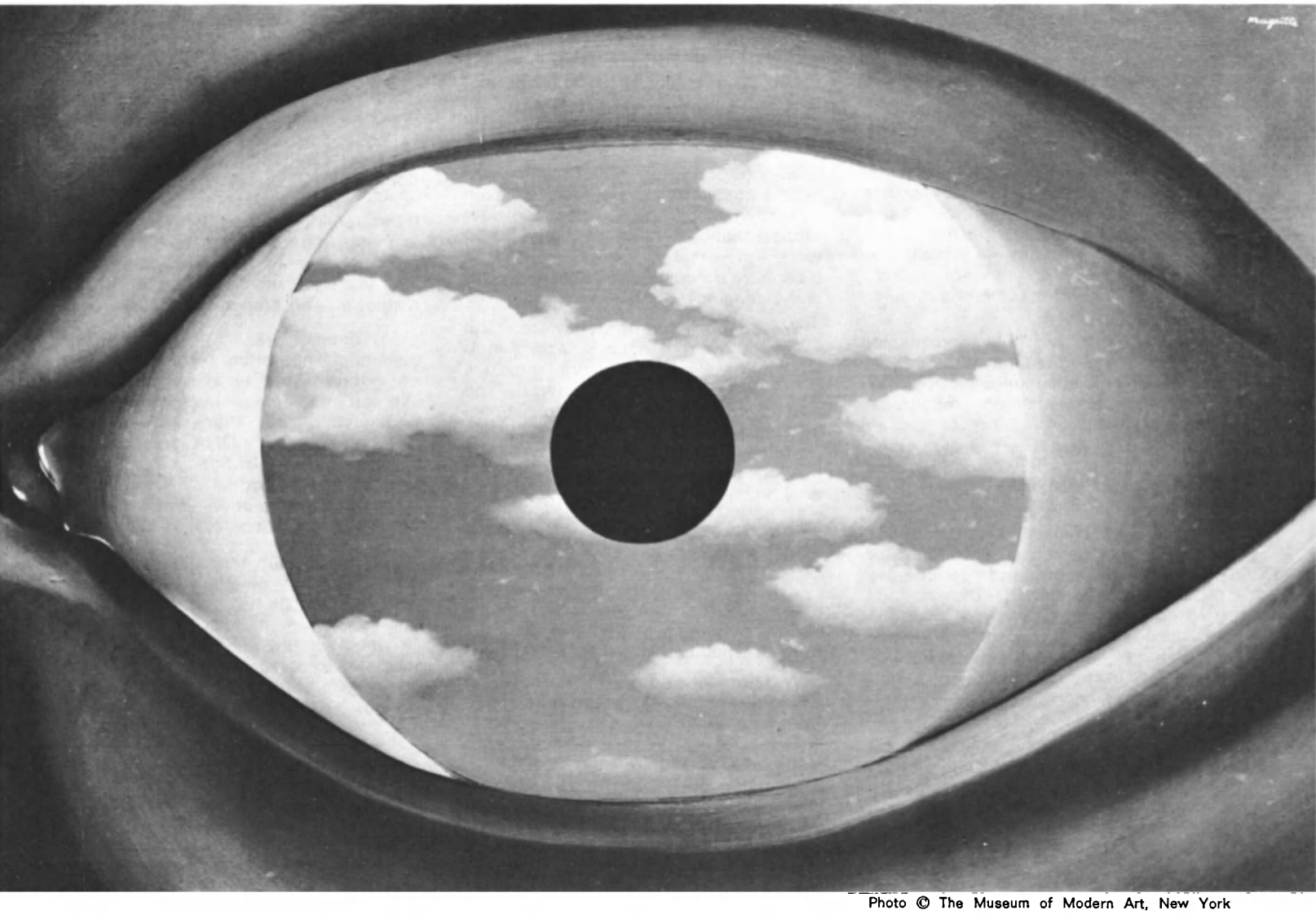

Photo © The Museum of Modern Art, New York

properties. Ultimately the oceans are one vast cistern with no outlet. This image is a safer one, perhaps, than that of infinite and "moving waters at their priest-like task of pure ablution round earth's human shores."

And it underlines the need for world-wide monitoring and research to ensure that over the next forty years of still continuing growth in people, industrialization, consumption and inter-continental transport we do not, unwittingly, take the oceans themselves past some still unmeasured threshold of "no-return".

● This concept of newly understood limits is relevant to the second reversal of earlier concepts whose implications I would judge to be most revolutionary for the present age. For over a century now and with increasing enthusiasm in the last 25 years, we have seen in economic growth, measured by the satisfaction of both ordinary and induced material needs, a prime aim of national policy and a powerful solvent of social conflict.

Inside the nation, as output and incomes rise, the flow of goods will be great enough to reward effort and enterprise and provide on an upward scale for the needs of the mass of the people. In the world economy, international trade and investment will pull the developing peoples up in the wake of the already developed nations.

This is a sort of "follow-my-leader" concept of economic satisfactions according to which, over the next fifty years, per capita incomes all round the world rise to meet, say, America's present annual average of $4,000—or, to use a concrete measurement, a million calories and thirteen tons of coal equivalent in energy. At the same time developed standards would rise to perhaps $10,000 or $15,000 per capita with a two-home, three-car, four-TV-set norm in the upper income brackets.

But this implicit assumption of unending expansion has two self-reinforcing flaws. Even within the wealthiest states, even with all the transfers of resources from richer to poorer citizens secured by tax and welfare and social insurance, "trickle down" economics do *not* ensure the ending of poverty at the base of society. The lowest twenty per cent can have as little as five per cent of national income, the top twenty per cent as much as forty.

In the world at large, where no systematic social transfers occur, the richer states are pulling away from the less developed ones. Even if $10,000 a year per capita is a reasonable likelihood for developed societies by the year 2000, for two thirds of mankind, $400 a year looks like being the utmost reach of optimism. For perhaps a third, malnutrition, illiteracy, shanty-town dwelling and unemployment—in other words, the worst of all human environments—could be the most likely fate.

But now we must add another constraint. Even if we assume unlimited resources with which to develop, development is, as we have seen, grossly uneven. But suppose there are indeed strict physical "limits to growth"? Suppose that these delicate mechanisms and balances in the biosphere that make life possible cannot sustain 10,000 million people all aiming to produce and consume and discard and pollute according to present developed standards?

Here, admittedly, the range of debate is very wide. Some experts believe that 20,000 million people can live at America's present standards simply on the products of atomic energy, water and the minerals in common rock. Others postulate irretrievable damage in terms of exhausted resources, thermal pollution, and environmental disruption if even half that number secure the current standards of the rich. We are at the beginning of this debate.

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But one point is surely clear. There are limits. The biosphere is not infinite. Populations must become stable. So must the demands they make.

But in that case, whose upward aspirations must first be checked? Given *finite* resources, we cannot evade this basic social issue. Where are the restraints to be put? What is to be reduced, the luxuries of the rich or the necessities of the poor? What are the priorities—a decent human environment for the whole human species or riches for some and squalor for the majority?

We can slide over this fundamental issue of environmental quality only if "trickle down" economics work within a context of unlimited resources. Neither assumption is correct. So, as nations, as a planet, we are compelled to confront the fundamental issues of choice and justice.

● But at this point we encounter a third basic challenge to our habits of thinking. Our effective instruments of judgment, decision and action are separate governments. The nations give our planet its colour, its variety, its richness of life and experience. For those to whom full nationhood has come only in the last quarter of a century, it expresses the essence of their being and their hopes.

None of this can be doubted. Yet it is also true that the cumulative effect of the separate actions of separate sovereign governments can, over time, injure the basic national needs of all of them.

If our airs and oceans can stand only so much strain before they lose their capacity for self-purification, it will help no government to say that others were responsible. The most flagrant case is clearly the risk of nuclear conflict and planetary nuclear pollution. We may rejoice that a number of intergovernmental agreements now limit atomic testing in the air, keep nuclear weapons from the seabed, Outer Space and Antarctica.

But we could collectively pollute the planet not "with a bang but a whimper"—by the small, steady accumulation of long-lasting poisons and pesticides, of chemicals and tailings, of eroded soil and detritus and reach, almost inadvertently, a creeping planetary disaster to which all have separately made their cumulative contribution. No single nation can avert this risk as numbers and activities rise. Its control will be achieved by nations acting together—or not at all.

And this raises by another route the issue of planetary justice—which equally cannot be solved by nations acting alone. How do we ensure that the need to check pollution does not become an inhibition on the desperate need of two thirds of humanity for development? This is an area about which we do not know too much.

It is certainly not clear that all non-pollutive technologies are more expensive. It is also possible that in opting straight away for pollution control, developing states could take full advantage of the greatest asset of late comers—to learn from other people's mistakes. Equally it is possible that to control wastes and effluents at an early stage of modernization would greatly add to costs and strains.

Should poorer countries then accept added costs for development or even their own modernization because developed nations have already, as it were, pre-empted so much of the biosphere's costless capacities for self-cleansing?

We do not know the answers. But we do know that nations, acting individually, will not necessarily produce a workable planetary answer. The relentless pursuit of separate national interest by rich and poor alike can, in a totally interdependent biosphere, produce global disasters of irreversible environmental damage.

THERE are then, I suggest, three vital ways in which the reality we are beginning to perceive diverges from our habitual thinking.

We normally consider Nature as a whole, the entire biosphere, to be safe from man, even if we can chip away at little bits of it. We have been taught to believe, with increasing intensity in recent decades, that we can modernize all our economies and settle most issues of distribution by our unlimited command of rising energy, technology and resources. And by our millenial history we have been taught to expect final decisions to be taken by separate sovereign states.

It requires a desperate wrench from accepted thinking, a profound leap, a Copernican leap of the imagination, to begin to see that in stark physical and scientific reality none of these pre-suppositions are any longer true. We can damage the entire biosphere. Resources are not unlimited. States acting separately can produce planetary disaster.

We all know enough of history to realize how uncertain it is whether this change in the direction of our thinking will be made in time. Custom and habit hold us to the traditional themes. The sheer momentum of our present activities could well be enough to drive us on for another four or five decades on our present path.

We could increase the damaging impact upon our biosphere, accentuate the deepening gulf between wealth and opportunity for an elite of developed states and a squalid and deteriorating human environment for everyone else. We could arrive at no intergovernmental agreements or strategies to check either kind of profound environmental degradation.

This is a possible "scenario". Realists might even call it the most likely one. But I would like to give you three reasons why I feel it is legitimate to entertain—shall we say, a modest hope?

The first is that the Stockholm Conference was held at all. Once the environmental concern moves nearer to the centre of the nations' attention, I do not doubt that its fuller implications will inevitably unfold. For its whole essence is interconnexion and interdependence. Its whole message is that separate drives, ambitions and policies have to be made compatible with the continuing common life of our single, shared planetary system.

My second reason is precisely this scientific imperative. We can cheat on morals. We can cheat on politics. We can deceive ourselves with dreams and myths. But there is no monkeying about with DNA or photosynthesis or eutrophication or nuclear fusion or the impact on all living things of excessive radiation—from the sun or the hydrogen bomb.

And what our incredible scientific breakthroughs of the last century have taught us is that the ultimate energy of the universe both sustains or destroys life and that the mechanisms and balances by which it becomes life-enhancing are fragile and precious beyond our belief.

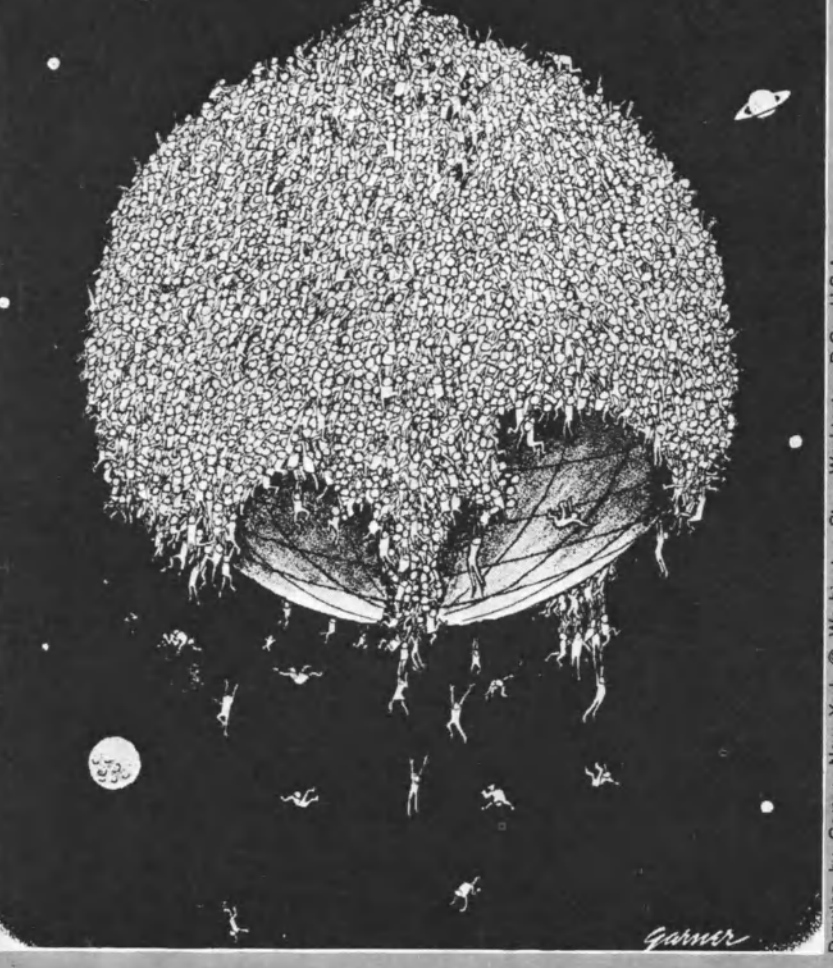
To act without rapacity, to use knowledge with wisdom, to respect interdependence, to operate without hubris and greed are not simply moral imperatives. They are an accurate scientific description of the means of survival. It is this compelling force of *fact* that may, I think, control our separatist ambitions before they overturn our planetary life.

But man does not live by fact alone.

Our *human* environment has within it our perpetual striving to make it humane as well. In the past, historians tell us, there have been profound revulsions against the aggression, pride and rapacity of human systems.

The great ethical systems of mankind—in India, in China, in the Middle East, from the benign wisdom of Confucius to the passionate social protest of the Hebrew prophets—all sought to express an underlying moral reality, that we live by moderation, by compassion, by justice, that we die by aggression, by pride, by rapacity and greed.

Now in these latter days, the planet itself in its underlying physical reality repeats the witness of the sages and the prophets. Our collective greeds can degrade and destroy our basic sources of life in air and soil and water. Our collective injustice can continue to create an intolerable imbalance between rich and poor. Envy and fear can unleash the nuclear holocaust. At last, in this age of ultimate scientific discovery, our facts and our morals have come together to tell us how we must live. I for one believe profoundly that they have done so just in time. ■



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THE LIMITS TO GROWTH

Interview with the President of the Club of Rome Aurelio Peccei

In April 1968, some 30 personalities from the worlds of industry, science, economics, sociology, government, etc. gathered in Rome at the Accademia dei Lincei, one of the world's oldest academies of science, for an informal discussion on the present and future predicament of man. It was from this meeting, instigated by Italian economist and industrialist Aurelio Peccei and the Organization for Economic Co-operation and Development's Scottish Director-General for Scientific Affairs, Dr. Alexander King, that the Club of Rome was born.

Peccei has described the Club as an " invisible college "; it has some seventy members from widely varied backgrounds who share a common conviction that it is urgent to redress the world situation. The Club aims to acquire and spread real understanding of the critical state of human affairs and the uncertain prospects for the future and to propose new policy guidelines for the intelligent management of human affairs.

As a first step the Club commissioned a team of scientists at the Massachusetts Institute of Technology, under the direction of Professor Dennis Meadows, to study the probable dynamics of the world situation with particular attention to the problems of making a deliberate transition from world-wide growth to global dynamic equilibrium.

Adopting the " systems dynamics " techniques originated by Professor Jay Forrester, Professor Meadows and his team produced a computer model of the complex, interlinked forces that affect man and his environment into which they introduced a number of variables that affect growth. They then proceeded to make projections of man's chances of survival in the future. Their ultimate conclusion was that all projections based on growth end in collapse.

This study, the first of a series commissioned by the Club of Rome, was published last year in the form of the now world famous book " The Limits to Growth". The book has aroused enormous controversy (see for instance pages 12, 14). In the interview accorded to Unesco recently, extracts of which we publish below, Mr. Aurelio Peccei, President of the Club of Rome, comments on some of the criticisms with which it has been greeted.

QUESTION : ***What method did the Club of Rome use for such a complex, global study ?***

Aurelio PECCEI : We based our study on five crucial trends of world concern which, as a starting point, can be said to represent the dynamics, complexities and dangers inherent in the present world system. The first trend is population growth. The second and third are the parallel economic factors of industrial and agricultural growth, in other words, the ability to meet the needs of the growing world population. The fourth factor is pollution, the contamination of the environment with unwanted by-products of industry and agriculture. The fifth is the use we make of our natural resources, the inherited world resources we deplete, all too heedless of the fact that we are living on the capital, not the income.

Q. : ***Your model comprises five highly complex variables. Did you take into account the variables within these variables?***

A. P. : The five variables we chose are interlinked and interact on each other. After trying to take into account all the data that could have a bearing on the interactions, we drew up over a hundred equations whose various curves represent these interrelationships. We fed them into a computer model designed to accept as many world variables as our knowledge or research could identify.

Q. : ***What global conclusions has the model helped you to reach ?***

A. P. : The model is largely indicative in character. Within two to five years we hope to arrive at much firmer conclusions. But the conclusions we

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can draw already are alarming enough. If present trends continue, exponential growth of production, consumption, pollution and depletion of raw materials will lead to a completely impossible situation: overpopulation of the planet, impoverishment of our environment with our atmosphere and water supplies polluted.

Q. : ***An optimistic viewpoint suggests that this alarmist attitude is exaggerated.***

A. P. : Our model is purely descriptive of a situation as it exists today and of the possible outcome if present trends continue; the project was not intended as a piece of futurology. The optimists say that the road ahead may seem dangerous but that human ingenuity, science and tecnology will be capable of solving many of the problems we now face. To my mind, the optimists fail to consider two fundamental factors. The first is the accelerating pace of history; our institutions and our ability to react to problems are not fast enough for us to master these problems in time. Events move more rapidly than we do.

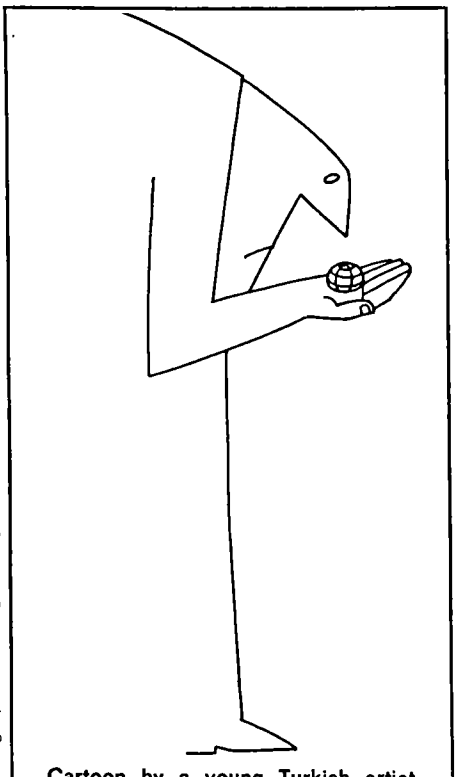
But the second factor is even more fundamental; critical world problems exist for which there are no technical solutions. These are problems of reaction, adaptation and values. Solutions for these problems will have to be sought in the context of social and cultural development. Thus, rather than increase the rôle of technology in the world, we should, perhaps, attempt to humanize it. This means that we must seek quite different solutions.

Q. : ***It is claimed that your model corresponds to the situation in industrially developed countries but not to that of the Third World, since it does not include social or political factors.***

A. P. : Such criticisms come closer to the truth. The real need is for a fundamental change in our political and social standpoints. If present trends continue we shall be heading for disaster. Yet we have no new models of the world. We want people to realize, now, that something must be changed in the world. I must stress that the model merely describes the present world situation with all its possibilities and problems. We wanted to learn from our model what this old earth of ours can provide globally and then consider how to make better use of it to eliminate inequalities and tensions.

I do not think it is possible today to have both a global and a detailed view of the world; we do not have the necessary techniques to do this. So our model must be improved in the years ahead—from only five parameters today to ten tomorrow—as well as in other ways such as a reappraisal of our institutions, etc. since these represent the needs of an evolving society.

In a society that will be both fragile and complex, when world population is double what it is now, I fear that computers and other tools that expand the capacity of the human mind will be a necessary aid to life. But if man could regain some essentially human qualities, if injustice were diminished, if wiser generations should succeed us, then perhaps we should have less need of computers to guide us. In short, the choice is between a raising of our ethical standards or an ant-heap existence. As men, I trust, our destiny is not to be mere ants with no higher aspirations than feeding ourselves and achieving material well-being. ■



Drawing © Ferruh Dogan, from "Cizgili Dunya", Ant Publishers, Istanbul

Cartoon by a young Turkish artist, film cartoonist and book illustrator, Ferruh Dogan (see also page 15) whose work has won many international awards, including the "Grand Prix" at the 1972 World Festival of Humour in Knokke-Heist (Belgium).

LIMITS TO THE LIMITS TO GROWTH

by Gunnar Myrdal

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THE recently published Report for the Club of Rome, *The Limits to Growth*, will probably have the useful effect of popularizing the ecologists' broad warnings of the necessity of giving up our expectations of continuing on the road of unrestrained growth. But to the serious student the report has grave defects in its very approach to the problems of both present trends and the possibilities and means of altering these trends.

To begin with, the report uncritically accepts the concept Gross National Product without any queries. Also for the rest, it builds upon, and aggregates in the most careless way, data that are extremely uncertain both in regard to economic growth itself and its various components.

The data concerning threatening pollution and depletion are equally unreliable. Even a popular presentation should contain a reminder of this, particularly as it is of importance for the use of these data in a system analysis.

Photo © from Cuadernos del Consejo National de la Universidad Peruana, Dec. 1971, Lima, Peru

GUNNAR MYRDAL *is a world renowned figure in sociology and economics. A member of the Royal Academy of Sciences in Sweden and former executive secretary of the U.N. Economic Commission for Europe, he is at present professor of international economy at Stockholm University. He is the author of many authoritative studies and books on social and economic questions, with special reference to the developing countries (see bibliography page 33). The article published here is an excerpt from a major address delivered as part of the Distinguished Lecture Series in Stockholm last year. The full text will shortly be published by W. W. Norton (New York) in a collection of these addresses.*

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The authors are, in other words, overselling their product in regard to the validity of the basic data.

Much more fundamental is the question of the realism of the report's global "world system analysis". This analysis implies, to begin with, a non-consideration of the enormous and increasing differences and inequalities within countries and still more between countries.

To explain this, the report states that "inequalities of distribution are defined as social problems" and then placed outside "the world simulation model", which only "calculates the maximum possible behaviour of our world system" provided that there is "intelligent action on world problems, from a world-wide perspective".

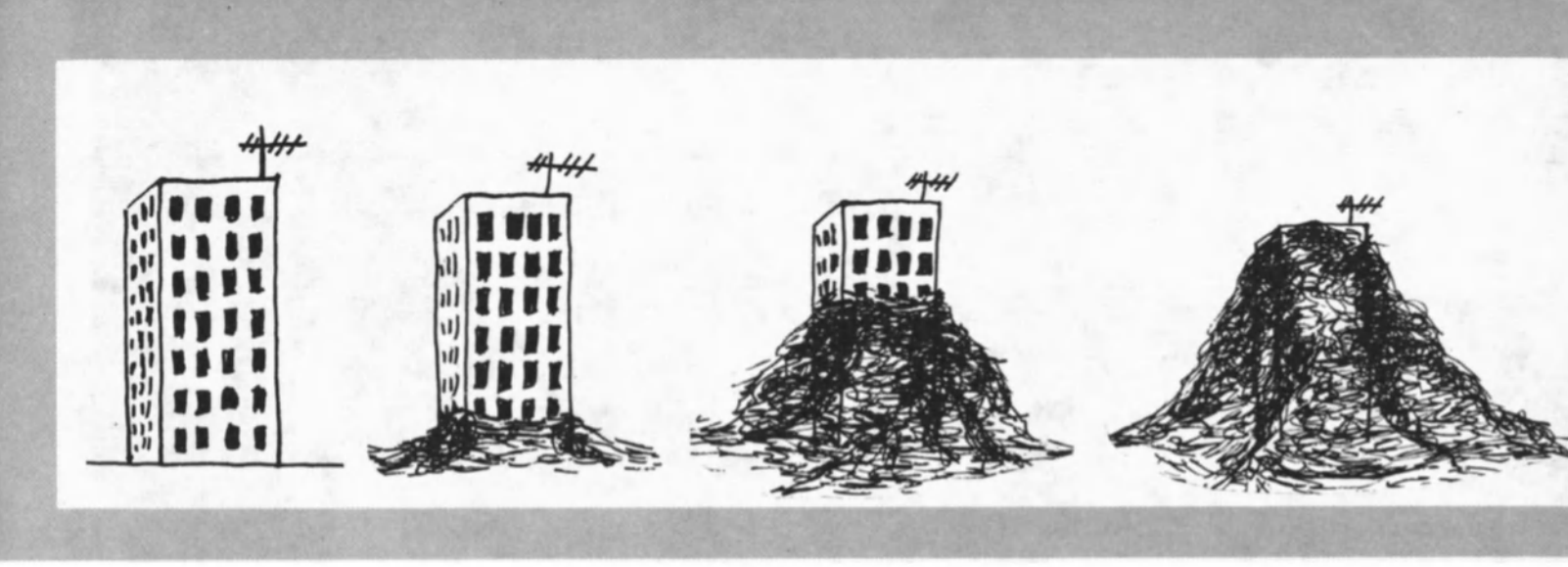
An economist working on these very problems will be hard put to give any intelligible meaning to this assumption of perfect harmony in the world. Still less will he be able to outline how it could be brought about. Particularly in a pretended system analysis it is simply not possible to get away from "the social problems" merely by stating that they are not taken into account. The ecosystem has to be studied as part of the social system I have mentioned.

More specifically the report places outside the "interactions" within the "world model" attitudes and institutions, indeed even the process of price formation, while politics is only represented by stating a number of the results of abstract policy alternatives. Their system is, therefore, far from inclusive enough to have meaning.

The birth rate, for exemple, is quite rightly a factor, and a very important one, within their model. But it is certainly not a function only of the other factors within that model and the interrelations between them all. As we who have studied the demographic development in the several regions of the world know, the movements of these other factors are not even among the most important determinants of the birth rate. And the importance of them is not through the simple interrelations of the model. Indeed, those interrelations are fictitious.

Under these circumstances the use of mathematical equations and a huge computer, which registers the alternatives of abstractly conceived policies by a "world simulation model", may impress the innocent general public but has little, if any, scientific validity. That this "sort of model is actually a new tool for mankind" is unfortunately not true. It represents quasi-learnedness of a type that we have, for a long time, had too much of, not least in economics, when we try to deal with problems simply in "economic terms".

In the end, those conclusions from the report's analysis which are sensible at all, are not different and definitely not more certain than could have been reached without that elaborate apparatus by what Alfred Marshall called "hard simple thinking aware of the limitations of what we know." ■



Young scientists' round table at Unesco

ENVIRONMENT AND POLITICAL COMMITMENT

IN the midst of the current debate on the environmental crisis, young scientists have made their voices heard on a number of important issues.

Over the past 18 months, Unesco has participated in several international meetings with young natural and social scientists: at Enschede (Netherlands) in July 1971, at a meeting organized by the World Federation of Scientific Workers on the theme "Young Scientists and Contemporary Society", and at Hamilton (Canada) in August 1971, at the International Youth Conference on the Human Environment.

More recently, on the eve of the 1972 United Nations Conference on the Human Environment in Stockholm, Unesco brought together a small group of young scientists from industrialized and developing countries, to discuss two recent models of the global future and the solutions which they suggest.

The two models were the Massachusetts Institute of Technology-Club of Rome study, "The Limits to Growth", and the United Nations World Plan of Action for the Application of Science and Technology to Development. In the event, the young scientists, meeting at Unesco's H.Q. in Paris, focused most attention on the first of these studies.

The Club of Rome initiative in making the study was generally welcomed. Doubts were expressed, however, on two quite separate issues: the methods used to construct the computer model; and the model's political implications, particularly in view of the "a-political" stance claimed by those who produced it.

The young scientists questioned the validity of the model on several counts, but directed most of their criticisms at its political aspects. For most participants, the selection of five basic parameters, of a purely technical nature, meant that the model was not one which applied to the real world situation.

Why, they asked, were war, the arms trade, colonialism and imperialism rejected as specific factors that might, and indeed already were, causing breakdowns? Why was the unequal distribution of resources, between nations and within them, not included in the analysis?

There was considerable agreement that all the model's assumptions were conditional on an unaltered status quo in world affairs; that it was a "conflict-free" model of a world which, in reality, is torn by conflict.

GNP (Gross National Pollution), a satirical comment on one unwanted product of the consumer society drawn specially for the "Unesco Courier" by a young French cartoonist, Maurice Mas. Other drawings by Mas on pages 16 and 23.

Drawing © Mas, Paris

The model was also considered to have some dangerous effects. One participant described it as a "recipe for stagnation" which would do, and had already done, far more to obscure ideas than the piecemeal approach of the world's politicians which the Club of Rome had sought to avoid.

As the young scientists saw it, one basic assumption behind the Club of Rome model is that world population growth is the essential cause of the future breakdowns in society that the model predicts. All the participants agreed that population growth is neither the only nor the main cause of the environmental crisis. Other factors involved are economic growth, the type of technology used, particularly in developed countries, the nature of existing political and economic systems, the high level of consumption in the developed world, etc., etc.

They saw high rates of population growth as a symptom, and not a cause, of underdevelopment which results from political exploitation of the developing countries by the developed.

Nearly all participants agreed that the problems of development, of family planning, of the relationship between rich and the poor countries and the problems of the environment, cannot be analysed as separate issues. The interdependence of these factors means that the "environmental crisis", as the industrialized countries term it, is in reality a multiple crisis or a series of convergent crises.

Young scientists from Third World countries, in particular, pointed out that a planetary disequilibrium had always existed to the detriment of the poor countries, broadly those in the southern hemisphere.

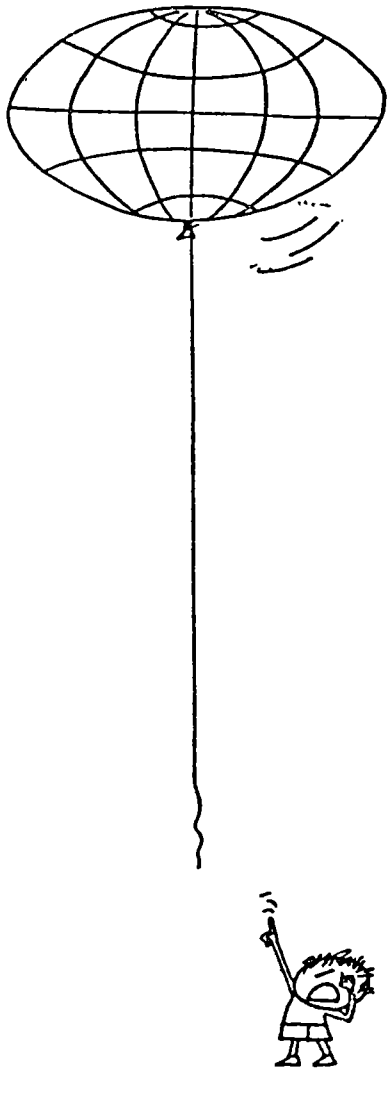
Problems of the environment and development were debated primarily in their political context and only secondarily, or not at all, in their scientific context. This reflects the increasingly prevalent view among young scientists today that science should be politically and morally committed; that the value of science is measured by the extent of its ethical commitment; and that the rôle of science should be seen as part of the political context.

They also stressed the importance of restoring public confidence in science. The man in the street should have a clearer understanding of the ideas underlying science.

But they warned against the dangers of technological domination. In many cases it would be better to improve traditional practices rather than introduce totally new forms of technology. The right attitude would be neither an unquestioning veneration of technological progress nor a blind subservience to tradition.

The young scientists outlined a major research programme which would for the first time investigate traditional labour technologies on a decentralized basis. The aim should be to put local resources and skills to maximum use and to make scientists out of laymen rather than humanitarians out of scientists. A great demand exists in developing and industrially developed countries for new technologies which are not harmful to the environment.

Finally, general agreement was reached on a number of basic principles: that science can never be a substitute for political debate, that men must once again be counted as men and not as statistics, that an obsession with quantity must give way to considerations of quality, and that global analyses must be replaced by regional and local solutions which will reintegrate man fully with nature and with the technologies he has created. ■



Drawing by the Turkish caricaturist Ferruh Dogan.

Drawing © Ferruh Dogan - Ant Publishers, Istanbul

Mediterranean: DANGER! OIL POLLUTION

by Carlo Munns

As a result of their proximity to some of the world's richest oilfields, the waters of the Mediterranean are used by a vast fleet of oil tankers.

Forecasts point to a staggering growth in these oil shipments during the next few years. In 1975, 360 million tons out of a world total of 1,650 million tons of crude oil carried by sea will be discharged at Mediterranean ports.

When the Suez canal is re-opened and the existing pipelines in the canal zone conveying crude oil from the Red Sea to the Mediterranean are brought back into use, some of the traffic now going round the Cape of Good Hope could well return to the Mediterranean routes.

But how is it that oil loaded on tankers for delivery to refineries finishes up in the sea?

Oil pollution in the sea is generally associated with an accident of some kind, one which arouses public opinion and draws attention to the high cost of cleaning up vast areas of water after an accident at sea.

In reality, the major problem of oil pollution in the sea is only partly due to accidents; operational pollution, bound up with the normal sea transport of oil and with loading and discharging operations at the terminals, is far more important. This is a more general source of pollution, less in the limelight than tanker accidents but far more insidious.

The fact is that less than 99 per cent of the oil taken on board a tanker is discharged at the port of destination. Part of the remaining one per cent is lost by evaporation of the most volatile elements in the oil and the rest settles on the walls and bottom of the tanks in the ship in the form of sediment.

These far from negligible quantities of oily substances represent a danger for the ship itself since they give off gases which may form an explosive mixture with the air in the now empty tanks. It is thus indispensable to rinse out the tanks with water.

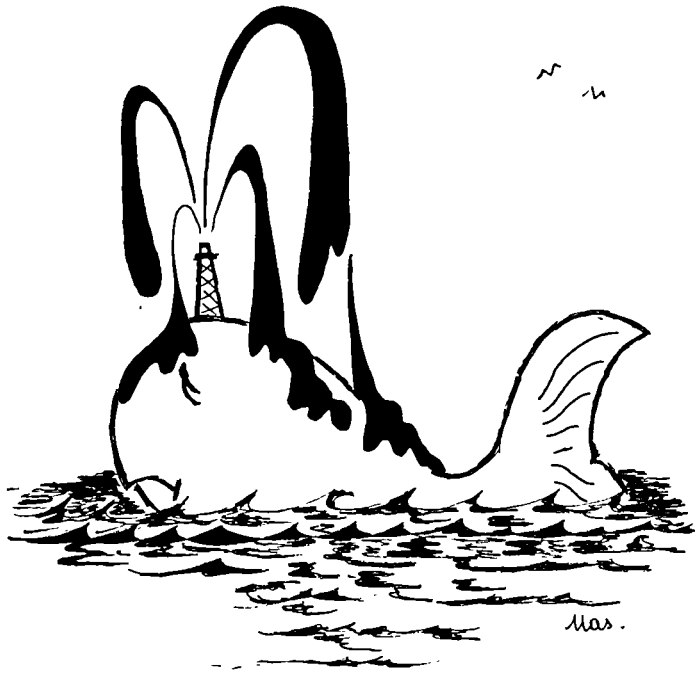
When a tanker has discharged its crude oil load and leaves again to pick up another shipment the washing of the tanks coincides with the need to take on sea water as ballast. Empty tankers are unstable and difficult to manoeuvre and therefore have to take on amounts of water varying from 40 to 60 per cent of their capacity.

This ballast, which forms an emulsion with the oily residue, has to be pumped out before a fresh cargo of crude oil can be taken on, so that large quantities of this residue find their way into the sea. The amount, according to the oil companies, is some 0.4 to 0.5 per cent of the oil carried, and it is one of the main causes of pollution.

Authorities in the oil-exporting countries do not tolerate the discharge of dirty ballast and tank-rinsing water near their coasts or in their ports, and place strict controls on the quality of water discharged. So tanker captains make a practice of discharging dirty ballast water on their way from port to port and of replacing it with clean water.

Although less toxic for the environment than radio-active substances, non-biodegradable detergents and plastics, crude oil creates an alarming problem because of the enormous volume transported and the high concentration in one area—the Mediterranean.

The natural environment in the area is obviously threatened by other factors: the increasing concentrations of population and of industry along the coastline, the development of the tourist trade, and the growth in consumption and in waste and refuse which,



Drawing © Mas, Paris.

CARLO MUNNS, *Italian expert on legal and technical matters concerning protection of the environment, is working with the Parliamentary Committee on the study of water problems in Italy and is collaborating in the drawing up of the first "Report on the State of the Environment in Italy" at present under preparation by the Italian Ministry of Scientific and Technological Research. He has also undertaken research projects on environmental questions for the Food and Agriculture Organization and the United Nations in Rome.*

in one way or another, eventually finishes up in the sea. But in terms of urgency oil pollution is the most crucial issue.

According to estimates, 300,000 tons of oil residue were discharged into the Mediterranean in 1970, and this figure will probably climb to 500,000 tons in 1975 and 650,000 tons in 1980.

But the Mediterranean presents some special problems. It is a shallow sea (only 3,500 metres deep at its central part), and its rising currents are not strong enough to assist in water exchange and oxygenation by contact with the air. Water temperatures at the bottom are more or less constant because of the protective effect of the Gibraltar threshold, and there are no currents moving faster than 2-3 knots.

The masses of water in the Mediterranean down to the first 150 metres thus take an extremely long time to mix and regenerate, a fair estimate being about 80 years.

Serious harm to the marine environment is therefore caused in a number of ways:

- The oil slick on the water prevents water oxygenation and instead consumes oxygen itself for its own degradation.
- Oil pollution is a serious obstacle to the photosynthesis on which depends the life and growth of the minute phytoplankton—the food of the zooplankton on which, in their turn, the larger sea creatures feed.
- Absorbed by fish, the pollutants eventually reach and endanger human life.

Every year, according to figures of the FAO General Fisheries Council for the Mediterranean, about one million metric tons of fish are caught in waters of this sea, and the protein requirement of the Mediterranean population increases yearly. Recent FAO reports indicate that some fish species are already decreasing.

The various governments, concerned at the worsening pollution situation, took steps to ban the discharge of tank-rinsing water within their territorial waters, with the inevitable result that the pollution has shifted to the high seas. In a closed sea like the Mediterranean this in turn causes pollution of coastal waters. The problem therefore called for a solution at international level.

The 1954 London Convention for the Prevention of the Pollution of the Sea by Oil prohibited all tankers from discharging oily mixtures containing more than 100 mg of oil per litre within 50 miles of land. In 1962, the 1954 Convention was amended, within the framework of the Intergovernmental Maritime Consultative Organization (IMCO). The ban now became absolute for all ships of over 20,000 tons and the protected areas were extended (from 50 to 100 miles in the case of the Mediterranean).

The result was that in the Mediterranean two zones were left, one between Libya and Sicily and the other south of the island of Rhodes, in which ships were free to discharge as much tank rinsing water as they wished. But in the absence of any effective monitoring system the discharge areas are expanding unchecked.

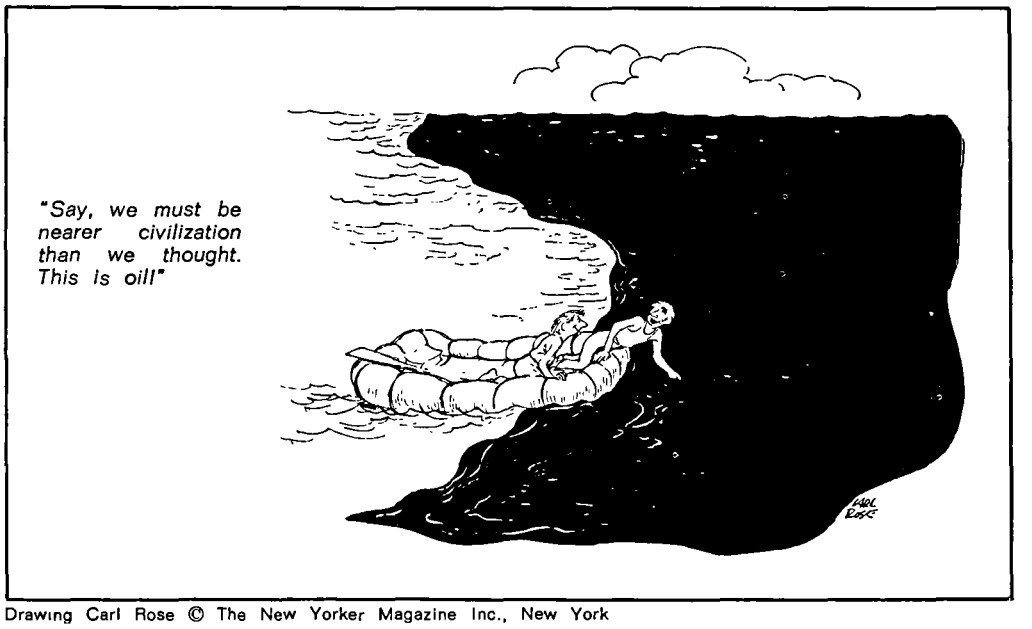
As an alternative to the rules laid down in the 1962 IMCO Convention, shipping lines and oil companies suggested a new way of rinsing out tanks known as the "Load on top" system. This process consists of separating the sea water from the oil residue during the return voyage. The water is cleaner when discharged into the sea and the oil residue from all the tanks is collected into one tank only.

This concentrated oil-water mixture is processed on board ship after the fresh cargo of crude oil has been pumped into the tanks, and is discharged separately when the tanker arrives at the refinery port with its new load.

In order for the process of separation by gravity to take place between water and oily substances a minimum of about 40 hours is needed, provided that the weather is calm. Unfortunately because of the short voyage time between crude oil embarkation ports in North Africa and the Near East and the user countries in southern Europe, tankers on these routes cannot effectively use the "Load on top" system. They have thus become chiefly responsible for the pollution of the Mediterranean Sea and coast.

Other techniques have been put forward to save oil from being discharged into the sea, but technically and economically they are difficult to implement in the case of the existing tanker fleet.

As long ago as 1954, IMCO affirmed that the only effective way of solving the oil pollution problem in the Mediterranean was to install plants for treating tanker ballast and rinsing water at all oil loading terminals. But because of the cost of building such plants the governments of the producer countries and the oil companies operating the terminals have not so far, with some rare exceptions, complied with the recommendation.



Drawing Carl Rose © The New Yorker Magazine Inc., New York

However, a recent study made for IMCO puts the cost of providing such new plants where they are needed and of improving existing ones at about 80 million dollars. Running costs would be about 70 cents per ton of oil shipped.

If these plants were built and operated, oil pollution in the Mediterranean could be reduced to negligible proportions within a space of three or four years. A solution is urgently needed, and many international research organizations now investigating the oil pollution question have made special studies of the problem in the Mediterranean.

The FAO General Fisheries Council for the Mediterranean has set up a "Working Party on Marine Pollution in Relation to the Protection of Living Resources".

Co-operating closely with Unesco's Intergovernmental Oceanographic Commission and with the International Commission for the Scientific

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Photo © American Museum of Natural History

Underwater wonderland of fish, shellfish and corals.

Photo William Sumits © Life, New York

Ugo Mochi at work at his glass easel. On it he lays a sheet of black paper and then a thin sheet of white tracing paper with faint outlines drawn on it. He cuts out the portrait with a pencil-shaped knife sharp enough to split a hair.

The two-horned, white rhinoceros. Formerly common in South Africa, only about 200 now survive in two reserves in Natal.

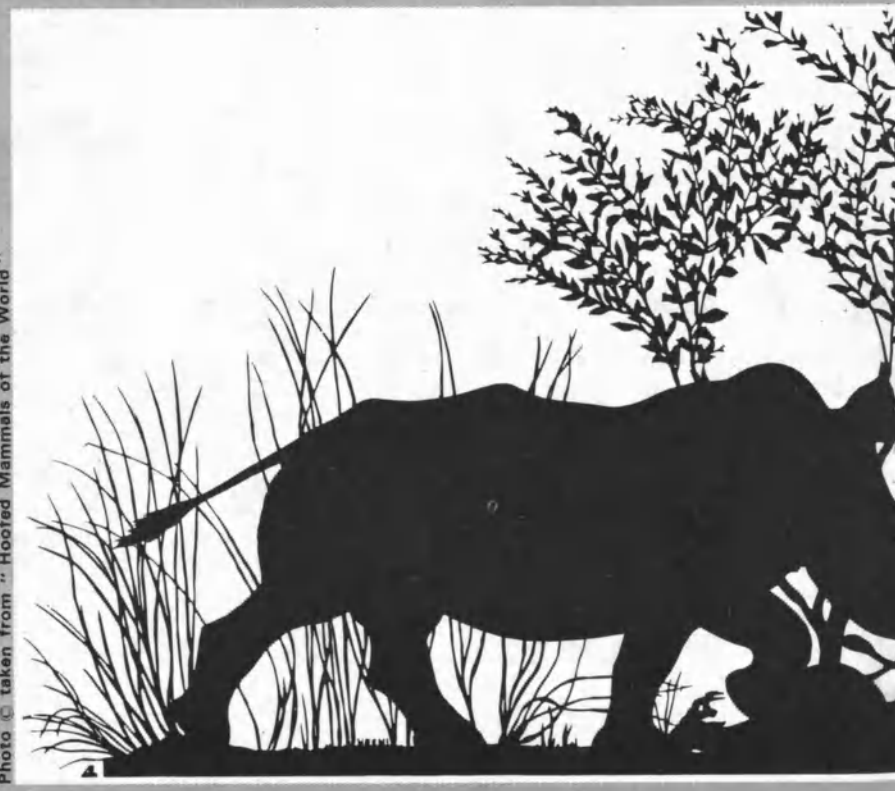

Photo © taken from "Hoofed Mammals of the World"

THE ANIMAL WORLD OF UGO MOCHI

An artist who has devoted the past eighty years of his life to portraying his love of nature and the preservation of wild life is Ugo Mochi (pronounced Mo-Kee), born in Florence, Italy and living in the United States since 1928. Mochi's medium is the shadow portrait cut out of one piece of paper which he has lifted to the realms of creative art combined with scientific accuracy. Fascinated by wild life from early childhood he has been making cut out portraits since the age of six. Some of his finest works (including many animals threatened with extinction) appear in "Hoofed Mammals of the World" (Scribners, N.Y. 1953) which he produced with T.D. Carter of the American Museum of Natural History. His works are to be seen in public and private collections in many countries including the Royal collection at Windsor Castle, England, the Berlin Museum of Natural History, the Metropolitan Museum of Art and the American Museum of Natural History in New York. Ugo Mochi's works though chiefly devoted to animal studies also include collections of major importance on "The History of Transportation" and "Portraits of Musicians".

Photo © American Museum of Natural History

A magnificent Australian Lyrebird, with tail feathers spread, and, below, his mate.

"It seems to me quite absurd", writes Josué de Castro, "to propose a zero economic growth rate for the Third World when the peoples of these areas consider economic development to be their last hope of emerging from their crushing burden of poverty."

POLLUTION PROBLEM N° 1 UNDER-DEVELOPMENT

by Josué de Castro

WHY should the so-called "underdeveloped" countries be concerned with problems of the environment? At first sight, these problems seem much more serious and more complex in the "highly-developed" countries, where intensive industrialization and urban growth damage or upset the balance of the natural environment. Pollution would thus seem to be almost exclusively a problem for the highly industrialized countries and to be of little interest to the poor ones, which supply the world's raw materials.

This analysis is quite wrong. It results from the vagueness of certain basic concepts, particularly the current concepts of "environment" and "development".

JOSUE DE CASTRO, *of Brazil, is famous for his efforts in the world struggle against hunger. He is the author of "The Geography of Hunger", 1952 (translated into 24 languages) and "Of Men and Crabs", 1970 (see also page 33). President of the World Association for the Struggle Against Hunger and former Chairman of the Council of FAO, he was Brazilian Ambassador to the U.N. in Geneva, from 1961 to 1964. Professor of Human Geography at the University of Brazil (Rio de Janeiro) since 1939, he is at present Associate Professor of Geography at the University of Paris (Vincennes) and President of the International Centre for Development, in Paris. He took part in the Environment Forum held concurrently with the 1972 U.N. Environment Conference in Stockholm, where he spoke on "Problems of Development and Environment in the Third World".*

The environment is not only the sum of all the material things that make up the mosaic of the countryside or landscape, and constantly interact with each other. It is much more than this. It also includes the economic structures and the outlook and habits of peoples in different parts of the world.

The environment as a whole therefore includes not only physical or material factors but economic and cultural ones as well.

An accurate analysis of the environment must always consider the total impact of man and his culture on all the surrounding elements, and also the impact of ecological factors on every aspect of human life. Viewed in this perspective the environment includes biological, physiological, economic and cultural aspects, all linked in the same constantly changing ecological fabric.

This concept is much wider and more objective than that of the environment considered merely as a system of mutual relations between living creatures and their natural environment.

The concept of "development" as measured only by statistics and increased material wealth—by economic growth—is just as false. Development also involves far-reaching and successive social changes which inevitably accompany the technological transformation of the natural environment.

The concept of development is not only a quantitative one, measurable in dollars, but also one that includes qualitative aspects of the communities concerned, in other words their quality of life.

To grow is one thing; *to develop* another. *To grow* is, generally speaking, relatively easy. *To develop* in a balanced way is much more difficult. So difficult, that no country has yet managed to achieve it. From this point of view, the whole world is more or less underdeveloped.

Yet it is the fashion today to speak of the harmful effects of economic growth on the environment and on nature in general. And people talk above all of the effects that are not the most threatening ones for the future of mankind. The most frequent cries of alarm condemn the population explosion, the pollution of air, rivers and seas, the degradation of animal and plant resources in the most highly-developed regions of the world.

This attitude reflects a limited view of the problem that takes into account only the direct effects of economic expansion, overlooking the insidious, indirect yet much more determinant action of development on all human societies.

The first serious mistake, the first

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Photo © H.W. Silvester - Rapho, Paris

The danger of ecological disintegration

false conclusion arising from this partial view of the problem, is the idea that it is the richest areas that were first affected by the pollution and destruction of the natural environment caused by economic growth.

The reality is quite different. The earliest and gravest effects of development were to be found precisely in the regions which are today economically underdeveloped and which were yesterday under colonial rule. Underdevelopment in these regions was the first result of the unbalanced development of the world as a whole. Underdevelopment itself represents a type of pollution and human degradation localized in certain regions unjustly exploited by the great industrial powers.

UNDERDEVELOPMENT is not, as is often supposed, the lack or absence of development. It is a product or by-product of development, an inevitable result of the colonial system of economic exploitation that is still in force in several parts of the world.

Many people are convinced that the whole question of environmental problems in developing countries is totally different from that in the rich industrialized countries, and should be viewed in quite a different way. In the poorer countries, they say, people do not concern themselves with the quality of life, but only with the chances of survival, with the struggle against hunger, disease and ignorance.

But these things are none other than the symptoms of a serious social malady—underdevelopment—which is itself a product of development. The underdeveloped countries which are struggling to survive need to take a direct interest in world-wide development and environmental problems so as to defend themselves against the aggressions their own environment has undergone for centuries on the part of the colonial powers.

If it is only recently that people have come to talk so insistently about the pollution and degradation caused by economic growth, this is because Western civilization, with its scientific and ethnocentric approach, has always refused to see what is obvious: that the hunger and poverty of certain far-off regions form part of the social price mankind pays so that economic development may advance in a few economically and politically dominant regions.

The blurring of this basic truth led to the institution on a global scale of a development strategy which inevitably resulted in the failure of the 1960-1970 Development Decade. This will happen again and again so long as the economic structures of the world continue to depend on the false foundations of its social structure: a war economy, a maximum profit economy, and a policy of economic oppression of the Third World.

To succeed in their struggle for emancipation and survival, the underdeveloped countries must obtain at all costs a marked reduction of the negative economic impact the market economy has had on their systems of economic dependence. These countries will have to fight hard against the indirect action of the great centres of accumulated capital, which perpetuate the underdevelopment of the world's economic fringe by every available means, including the refusal to stabilize the cost of raw materials.

To eliminate any doubt that in a consumer civilization underdevelopment is a product of development, it is enough to remember that before the capitalistic and industrial explosion of our century, there were no developed and underdeveloped countries separated by a wide economic gap. It was only after the second industrial revolution that the extreme disparities of growth rates and economic levels between the two groups of countries came into existence.

Let us take a concrete example: the average income per inhabitant of countries representative of the two groups—the U.S.A. and India. Before the first World War, the average income per head in India was 8 times less than that of the U.S.A.; before the second World War it was 15 times less; today it is 50 times less...

The economic degradation of the underdeveloped countries must be considered as a pollution of their human environment by the economic abuses of the dominant areas of the world economy. Hunger, poverty, widespread disease that would be avoidable with a minimum of hygiene, a short average life-expectancy: all these are products of the destructive effect of world exploitation under a system of economic domination.

Starvation in India, Peru, San Domingo or the North-East of Brazil may look like a local symptom of underdevelopment, but in reality it represents a paradoxical aspect of the diseases of civilization. Hunger is an indirect result of unbalanced economic growth, just as cardio-vascular and degenerative diseases are elsewhere.

Ultimately, the two groups of maladies—the so-called diseases of civilization and the diseases of poverty—are products of the same despotic and frenzied civilization of profit. The first ones are produced directly, on the spot; the others indirectly, at a distance.

A development strategy that envisaged the social reality of the Third World as something apart from the rest of the world doomed from the start any hope of improving environmental conditions. In reality, the whole biosphere is a single ecosystem composed of a multitude of sub-systems.

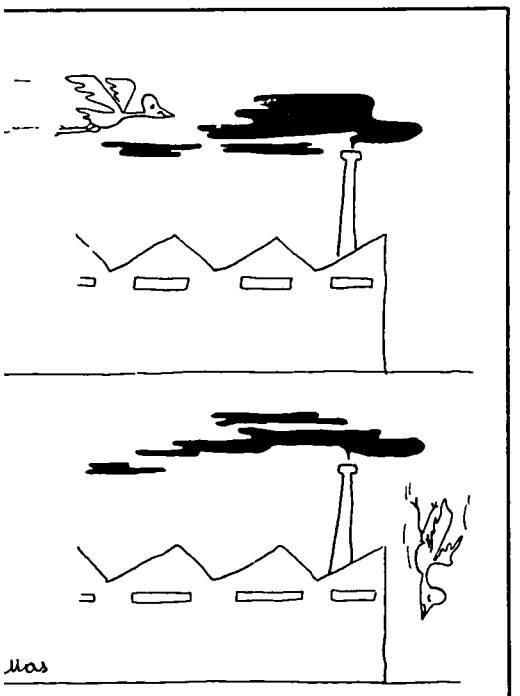
The ecosystem of the biosphere is given an enormous structural elasticity by mechanisms which compensate and counterbalance the negative impact of man's actions. This elasticity gives an important advantage to man, since it allows him to transform the biosphere and use its elements to satisfy his own needs. But the process cannot continue beyond certain limits fixed by the laws of natural balances (nuisance thresholds) without causing serious breakdowns, which may be fatal for the ecosystems.

THROUGH the play of ecological interactions, the serious imbalances to which the Third World has been condemned threaten the whole biosphere and with it all mankind. Starvation in the Third World could one day lead to world-wide pestilences; the revolt of the hungry could lead to war on a planetary scale. Starvation and war are themselves symptoms of a dynamic disequilibrium in the social and economic environment of our planet.

But it is not enough to consider only the indirect effect of development on the Third World's environment —an effect which is economic or cultural rather than purely physical or natural. We should also consider the threat of direct action: the thoughtless waste of non-renewable natural resources and the biological unbalancing of ecological sub-systems.

The Third World lives under the permanent threat of the on-the-spot installation of types of technological development which fail to take the ecological dimension into account and which could therefore cause the total disintegration of ecological structures. And if we consider the relative fragility of certain equatorial and tropical ecosystems, where most of the Third World is situated, the danger appears even greater.

It is well known that the soils in these areas are easily eroded when their covering layer of vegetation is



Drawings © Mas, Paris

over-exploited; and that the upsurges of tropical rivers are curbed by barriers composed of certain types of plants, which to some extent regulate and direct their flow. The destruction of this vegetation may lead to floods or to stagnation and other serious disasters such as the loss of flooded crops or the spread of endemic diseases carried by insects proliferating in stagnant water.

Does the fact that technological progress and economic growth are at present destroying the Third World's environment justify the halting of growth in these areas, as some people insist? I do not believe so. It seems to me quite absurd to propose a zero growth rate for the Third World when the peoples of these areas consider economic development to be their last hope of emerging from the crushing burden of poverty. I do not think those who oppose development are right to call a halt, when the urgent need is for a reconversion of development.

Technology in itself is neither good nor bad. It is its use which gives it an ethical meaning. If technology has worked against the Third World, this is because it has been used with one aim in view: maximum advantage and profit. It is neo-colonialist exploitation that has led these countries to their present state of despair, now aggravated by the new threat of stopping the little progress they have made in recent decades.

A great deal has been said about the report drawn up for the Club of Rome by the Massachusetts Institute of Technology, with the help of computers. The report establishes the limits of future growth with regard to the harmful effects of technology and industrialization as zero-growth for the world economy as a whole.

While, superficially, the report appears to be right—for we are all alarmed by the pollution and destruction of the human environment—it cannot be accepted outright because its conclusions have been distorted by methods that can hardly be called scientific.

The report supposes that the development model it presents, which paints the portrait of the world in a century's time, is the only valid one that can be built with available data on present world realities. This exclusiveness, typical of the ethnocentric culture of the highly developed countries, reveals the unscientific nature of the report.

One cannot forecast a single model of the future. All those who study futurology are well aware that one cannot envisage a unique future determined by the various conditions prevailing at the time of the study. All that can be done is to *imagine a series of probable futures* according to the Theory of Probability, which has replaced the deterministic attitude that was the rule before the adoption of the Theory of Relativity. So one can very well project several models of the world of tomorrow.

One can estimate, with a high risk of error, the probability of any of these models becoming a reality. But it is quite impossible to limit a scientific forecast to one single model. To make linear projections, as was done for the report on the limits of growth, is a naive procedure which does not take into account the structural breakdowns which are a characteristic feature of modern times. We live in a period of discontinuity, not one of continuity.

The worst mistake of the M.I.T. report is not to have included the problem of economic, social and political structures among the factors determining growth. In the introduction to the report the authors only consider five development factors: population, agricultural output, natural resources, industrial output and pollution.

There is not a word about the problem of social and economic structures. Yet everybody knows that the level of production and the level of pollution—i.e. the state of development and the state of the environment—essentially depend on the type of structure dominant at a given place and time.

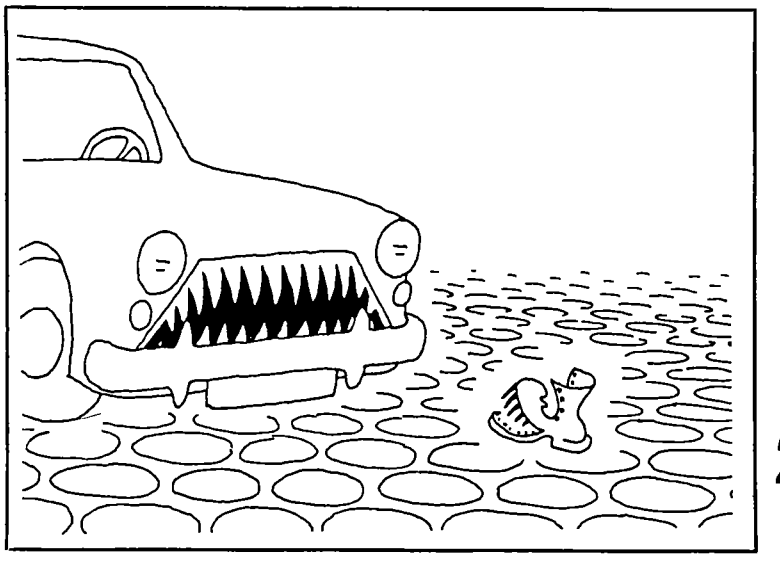
By leaving out man and his culture, the project has become alienated, for it does not take into account the realities of the modern world and therefore the realities of the future.

If the majority of Third World countries reject the conclusions of this report, it is because they are suspicious of this proposal to stop growth, which risks affecting the poorer regions of the world alone, since the rich ones will obviously not obey it. So the gap between the two worlds will increase.

If this is true, all the charitable paternalism of the Club of Rome towards the countries of the Third World will turn out to be a trap. Far from being helped by this kind of recipe, they will be enchained for ever in underdevelopment and poverty.

The reaction of these countries should be to try to find a type of development that would be independent of neo-colonialism, applying techniques created on the spot—the only ones that would be valid and rational. The present type of development, as I see it, is obviously a failure; but the world could be developed if it were given social and economic structures and means of production different to those which exist today.

But before this can be done, the war economy in which we live must be reconverted into a peace economy, and the enormous savings resulting from partial disarmament must be used to obtain a type of pacific development that would be not only more equitable but also non-polluting. ■



Drawing © Konk, from "Konk", Caliban series, Editions Ouvrières, Paris, 1972

A tree grows in Chuquicamata (Chile)—but only because it is protected and cared for like a fragile plant in the Atacama desert where this city with world's most productive copper mine is situated. Coaxing trees to grow in an industrial atmosphere and arid climate is no easy task.

THE MYTH OF ECOLOGICAL EQUILIBRIUM

by Miguel A. Ozorio de Almeida

PERHAPS the best way to put the environment issue in proper perspective is to ask straight away the basic question: according to whose criteria is the environment to be considered healthy, adequate, pleasant, desirable?

If the subject were an anaconda, and if the anaconda had a mind capable of value judgments, it would probably suggest that the world should be a swampy forest; a dromedary would wish it to be a desert. But what should it be for the human race? Certainly not all desert or all swamp.

A certain misunderstanding has permeated the whole debate on environmental protection and restoration, even in relatively sophisticated circles—namely that we have to keep or protect environment or ecological "equilibrium".

The problem to be solved in fact is not achieving an "ecological balance" but, on the contrary obtaining the most efficient forms of "long-term ecological *imbalance*". The problem is not to exterminate mankind now, in the name of ecological equilibrium, but to prolong our ability to use natural resources for as long as possible.

A basic misunderstanding of this reality—and the consequent striving for ecological balance—has led to many ill-founded conclusions, both explicit and implicit. Some suggest that mankind reduce its numbers, or be content with consuming less, or both. The most interesting aspect of these conclusions is that the "concluders" generally tend to shift the burden of reducing numbers or of consuming less to some community other than their own.

But with only marginal exceptions the great polluters are the highly industrialized countries. Starting from radionuclides (practically 100 per cent of whose production and dissemination is imputable to a few highly developed countries) and going right on down the list of all the other major pollutants, the overwhelming discharge of effluents is the consequence of the developed countries recent technologies and of their high levels of industrial as well as primary production (particularly in over-fertilized, over-herbicided, and synthetically controlled agriculture). The contribution to this type of pollution by underdeveloped countries is, in absolute terms, extremely small and in relative terms practically nil.

It could be said that *if all pollution generated by the developed countries could be withdrawn from the earth, there would be no pollution of world-wide significance; conversely if all pollution directly imputable to activities in underdeveloped countries could be withdrawn from the world today, all dangers linked to pollution would continue to exist in practically the same densities.*

The possible exception is the pollution that originates in the existence of humans at low levels of income: to be many and to be poor is offensive to the sight and feelings of some people. So far most proposals in this area do not concern co-operation to reduce population. It is even neatly construed that by reducing numbers per capita income will increase.

It is forgotten that there is a functional relationship between population and the ability to grow economically and that, if in certain areas, mostly in Asia, human numbers have become excessive (probably on account of colonial policies of the last century), in most of Africa and Latin America human densities are still below ideal levels for efficient economic development.

The threat of pollution is an area in which there has been a lot of pseudo-scientific extrapolation of the doomsday variety.

We are threatened with the melting of the polar ice-caps, the consequent rise in sea levels, and the wholesale drowning of some of the largest cities and capitals in the world.

We are threatened with the exhaustion of the oxygen reserve on earth because of North American and European over-consumption of this useful gas, while certain effluents dumped into the sea are jeopardizing its algae oxygen-producing ability. We are also told that the Brazilian occupation and utilization of the Amazon forest will eliminate its ability to compensate for American oxygen voracity.

We are threatened with cancer; everything that may be an irritant to human tissues—from love-making to all sorts of organic and inorganic compounds—may produce cancer.

We are threatened with hunger. We are threatened with emphysema. We are threatened with poisons. We are threatened with numbers that may be expected to eliminate all elbow-room on our little, already half-scuttled "spaceship" earth.

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MIGUEL A. OZORIO DE ALMEIDA, *special adviser to the Foreign Minister of Brazil, headed the Brazilian delegation to the United Nations Conference on the Human Environment at Stockholm in 1972. Ambassador Almeida has been closely associated with the U.N. since 1948, in particular with the Economic and Social Council, and was Brazilian delegate to the 1952 Unesco General Conference.*

Photo H. W. Silvester © Rapho, Paris

The sensible question to ask about these dire predictions of course is: how probable are these threats and how long before they become realities?

One of the answers to this question has been provided by the secretariat of the 1972 Stockholm Conference. In a balance sheet listing of what are believed to be the twenty-one most important pollutants, the state of knowledge about effects other than acute toxicity to experimental mammals has been indicated as uncertain in all cases but one.

Another answer to the same question may be induced from the very nature of most of the dramatic predictions made. Let us take, for instance, the consequences of the accumulation of carbon dioxide and the melting of the polar ice-cap. The first observation this evokes is that no index of probability is attached to this prediction, which reduces its scientific value.

Our planet had already passed through great variations in temperature long before modern industry and technology started tampering with its ecology. Each "warming up" period has generated an opposite "cooling off" tendency. Moreover, it should be noted that carbon dioxide accumulates simultaneously with other effluents, mostly particles, which reduce solar radiation reaching the earth and thus tend to cool its surface.

As for the time span that these predictions assume, if they apply to the next ten years, we had better act right away. If, however, it is a question of a hundred years, we may have the time to improve our knowledge and thus risk fewer mistakes in dealing with the problem. If it is one thousand years, the threat must be discounted, since it is not realistic to predict the burning of fossil fuels for such a long time. If it is one hundred thousand or one million years, let us forget about it.

The truth is that we do not yet know enough to pass judgment and take action in quite a few of the more important fields. Ecology, through its necessarily very broad, general equilibrium approach to the ecosystem, is still very far from a complete science, either as a methodology or as a body of accepted facts.

The old scientific approach is inadequate and the new ecological approach is not yet sufficiently ripe. This leaves us with a probabilistic outlook; quite a few of the threats now being made are illegitimate and another few probably true, but it is hard to tell one group from the other. What should be done in these circumstances?

The DDT battle continues

An international group of experts on pesticides, who met in Rome in November 1972, supports the continued use of DDT in agriculture. "The benefits to man arising from the proper controlled use of DDT will outweigh the possible risk from exposure", declared the experts, advisers to the Food and Agriculture Organization and the World Health Organization. The benefits of DDT, said their report, lay in the prevention of food losses to pests which would be disastrous in the developing countries (see also the "Unesco Courier", June 1971, July 1971, February 1972, May 1972). The experts also defended the use of mercury-based fungicides, whose risks they considered negligible. But they recommended further research to discover completely harmless yet equally effective replacement fungicides.

The first step should be to identify those cases of pollution that have international significance and then, within the limits of available knowledge, to determine the degree of probable urgency for the necessary action. It is quite clear that the existing situation of incomplete knowledge precludes drastic action in most fields.

Action might worsen the situation rather than improve it—as was true in the case of smog clearance in Los Angeles, where efforts to reduce carbon monoxide in the exhaust of motor vehicles led to measures provoking the equally harmful production by high-powered engines of nitrogen oxides and the highly poisonous nitrogen dioxide. In the same way the abolition of the use of DDT and other persistent organochlorine insecticides could drastically increase malaria and reduce agricultural production in tropical areas.

The second step should thus aim at sensible improvement of the situation, as much as possible by reduction of emission of the major sources of pollution and in areas where the carrying capacity of the environment has been clearly overtaxed.

This brings up a happy coincidence, namely, that the largest sources of pollution are to be found in highly developed areas, where the largest economic and technological resources that are a necessary condition for the ability to act on environmental problems are also concentrated.

The third step should be the initiation of adequate research for all areas where danger seems to lurk, thus creating the appropriate basis for future action.

The legitimacy of yet another range of problems—relating to the pollution of poverty or underdevelopment—must be carefully scrutinized. In rural areas, pollution mostly consists of poor sanitation and of food and water contamination, and the major pollutants are micro-organisms disseminated because of the lack of appropriate sewage. In urban areas the same problems exist together with quite a few others linked to excessive urban densities at very low income levels. The squalor of poverty itself is one of the ugliest faces environment may acquire.

A third characteristic is that, contrary to the prevailing conditions in developed countries, such pollution tends to diminish with economic development itself. In fact it is impossible to correct this particular pollution process, mainly because the resources necessary to cope with it are not available at low levels of income.

It is thus highly inappropriate to discuss these problems, both rural and urban, outside the framework of economic development.

Nor is pollution the only problem of environmental degradation linked to poverty. Problems of agricultural soil conservation and of different types of urban deterioration are also essentially the result of the economic inability to act. The prevailing conditions in the rural areas of developing countries are based upon a fundamental lack of capital resources, whether in terms of equipment or in terms of inputs for the improvement (or even maintenance) of soil conditions.

In urban areas, most problems of environmental degradation are linked to the inadequacy of productive employment in industry. This is the consequence of the inappropriateness of imported technologies to the factor endowment of underdeveloped countries, where labour tends to be plentiful and cheap but is not being fully utilized within the framework of the internationally available technologies.

All proposals so far made for the solution of urban degradation in underdeveloped countries do not touch upon the core of the problem, which is technical and economic. By concentrating upon *consequences* and ignoring *causes*, this approach represents

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Ten major pollutants

1	CARBON DIOXIDE		Normally the result of energy consumed in power stations, in industry and homes. It is thought that accumulation of this gas could significantly increase the earth's surface temperature, with the possibility of geochemical and ecological disasters.
2	CARBON MONOXIDE		Results from incomplete fuel combustion, mostly in the steel industry, in solid waste disposal, in oil refineries and in motor vehicles. Some scientists believe this highly poisonous gas may adversely affect the stratosphere.
3	SULPHUR DIOXIDE		Smoke from power generating plants, industrial factories, automobiles and fuel used in the home often produces sulphuric acid. The polluted air aggravates respiratory diseases, corrodes trees and limestone buildings, as well as certain synthetic textiles and vegetation.
4	NITROGEN OXIDES		Produced by combustion engines, aircraft, furnaces, incinerators, excessive use of fertilizers, forest fires, industrial plants. Causes smog, may lead to respiratory infections and bronchitis in new-born children. Causes excessive growth of aquatic plants, depletion of oxygen, loss of fish and degradation of water quality.
5	PHOSPHATES		Found in sewage, especially in detergents, in over-fertilized land and the consequent runoff into water, and as wastes from intensive animal farming. A major factor in the degradation of lake and river water.
6	MERCURY		Resulting from combustion of fossil fuels, the chlor-alkali industry, electrical and paint manufacture, mining and refining processes, the pulp and paper industry, Mercury is a serious food contaminant, especially of seafood, and is a cumulative poison that affects the nervous system.
7	LEAD		Principle source the anti-knock additive in petrol, but lead smelting, the chemical industry and pesticides also contribute. It is a cumulative poison that affects enzymes and impairs cell metabolism. Accumulates in marine deposits and in drinking water.
8	OIL		Contamination due to the operation of oil tankers, shipping accidents, refinery operation, offshore oil production and transport wastes. Has disastrous ecological effects including damage to plankton, marine life and sea birds as well as pollution of beaches and estuaries.
9	DDT AND OTHER PESTICIDES		Very toxic to crustaceans at extremely low concentrations. Used mostly in agriculture. The runoff of these products into the water kills off fish and their food and contaminates man's food. May have a cancer-producing effect, and may reduce population of beneficial insects, thus helping in the creation of new pests.
10	RADIATION		Mostly produced in nuclear fuel processing, and also in weapon production and testing and nuclear-powered ships. Has important medical and research uses, but above a certain dose can cause malignant growths and genetic changes.

The symbols used above are taken from "Symbol Sourcebook; an Authoritative Guide to International Graphic Symbols" by Henry Dreyfuss, McGraw-Hill Book Company, New York, 1972, $28.50. The Table of Contents is published in 18 languages and the book is divided into practical, easy to use sections dealing with : Basic Symbols, Disciplines, Colour, Graphic Forms. A comprehensive index makes reference simple.

Three roads to world sanity

a serious diversion of resources from development and constitutes an inefficient attack upon the problem.

An implicit assumption has been that, given the present demographic magnitudes and distribution in the world and given the present patterns of consumption of natural resources and of emission of pollutants by the developed countries, the world cannot afford the economic development of the underdeveloped countries along the lines followed by the presently developed ones.

If the three-fourths of mankind represented by underdeveloped countries were to squander natural resources at the same rate (in per capita terms) as, for example, the United States or the Western European countries, there would not be enough oxygen to go around and there would not be enough metals for industry, while, on the other hand, there would be so much carbon, sulphur, and nitrogen dioxide that mankind would be pushed toward extinction.

As a result of this line of reasoning, three basic measures are being proposed:

- explicitly, the control of population growth in underdeveloped countries;
- implicitly, a ceiling on the development of underdeveloped countries; and
- explicitly, a reduction of the emission of major pollutants by developed countries.

What this scheme obviously lacks in logical symmetry—if not acceptability—is a fourth measure: that overpopulated countries reduce their own demographic numbers and, if necessary, their industrial "predation" upon nature so as to reduce their claim upon the natural resources of underdeveloped countries.

It is of course impossible for underdeveloped countries to accept internationally agreed ceilings for their population and for their economic development. These ceilings are made all the more unacceptable by the underlying assumption that the populations and development levels of developed countries are taken for granted and not liable to discussion, change, and correction. Lack of knowledge about the earth's capacity to sustain human life would make such ceilings anything but a scientific necessity.

Plans for the Stockholm Conference were marked by the attitude that the developed countries have demonstrated, by their development, a special right to salvation and perpetuation, thus passing on to the more numerous underdeveloped peoples the responsibility for creating the necessary space on earth. This attitude is all the more dangerous for being implicit and not normally discussed in public.

Emphasis upon population growth, as such, unlinked to the relationship of the population to the national resource base—including geographical space—is inadequate and unacceptable.

Countries with more than 100, 200, or even 300 persons per square kilometre are thus left outside this approach, while countries with fewer than 20 inhabitants per square kilometre are being condemned for demographic policies that would bring about increased economic efficiency and constitute a necessary condition for their national integration and fulfillment as a human community.

ESSENTIAL to the Stockholm approach to environment is the assumption of the universal right of all peoples to share in the earth's natural resources. These resources are not the so-called common goods, like the high seas or the bottom of the oceans, but the mineral, animal, soil, and other resources within national boundaries.

This is, of course, a very beautiful assumption, but it would fit better in the institutional framework of a world government and we should not forget that we are still very far from this idea.

United Nations action takes place within the framework of a world divided into national states having a high degree of sovereignty over the resources within their borders. This is a fact of life that, until changed, must be kept in mind.

If this were not so, the still untapped natural resources of underdeveloped countries—very often their only assets and basis for development—would quite likely be placed by the Stockholm Conference within a World Trust and thus at the disposal of the voracious industry and consumption of highly developed countries.

Simultaneously the developed world, closely sheltered by its national boundaries, would keep basically unchanged its economic power, its industrial productivity, and its financial control of the international community.

It should be understood that what is necessary is either one universal framework for all sectors, or a national framework for all sectors. If resources are shared in trust by all peoples, then economic power, industrial productivity, and financial control should also be shared. Since the latter is considered unthinkable by developed countries, the former should also be unthinkable by underdeveloped countries.

A sensible approach at this stage should be to:

- Establish conditions for more research in critical areas of the environment field;
- Muster countries to initiate national and international efforts to prevent the unneccessary loss of unrecoverable resources;
- Provide for a better dissemination of knowledge in the broad area of environment.

In more specific areas, there should be a commitment by the great polluters of world-wide significance to take measures to reduce pollution at the source, or to compensate or neutralize its effects wherever they are felt. And measures should be formulated to accelerate development of underdeveloped countries so as to reduce the environmental degradation consequent to poverty and help in the creation of additional resources for environmental restoration alongside the development process.

Furthermore, an effort should be made to prevent the transfer of part of the costs of environmental improvement in developed countries to the underdeveloped peoples, through trade or financial or technological manipulations.

This is the moment of history in which modern science and technology, making full application of both accumulated knowledge and potentialities, is, perhaps for the first time, on the verge of carrying out its promises to provide abundance for all mankind. And the most important point I can make is that now, more than ever, we must not allow ourselves to be cheated of our opportunities, to be swept into a period of unnecessary panic, impelled by a lamentably short-sighted interpretation of trends.

We must not meet unjustifiable fears with dreary solutions: scarcity for all, reduction of population, and masochistic castigation of present and future generations through economizing on resources that are far from exhausted. ■

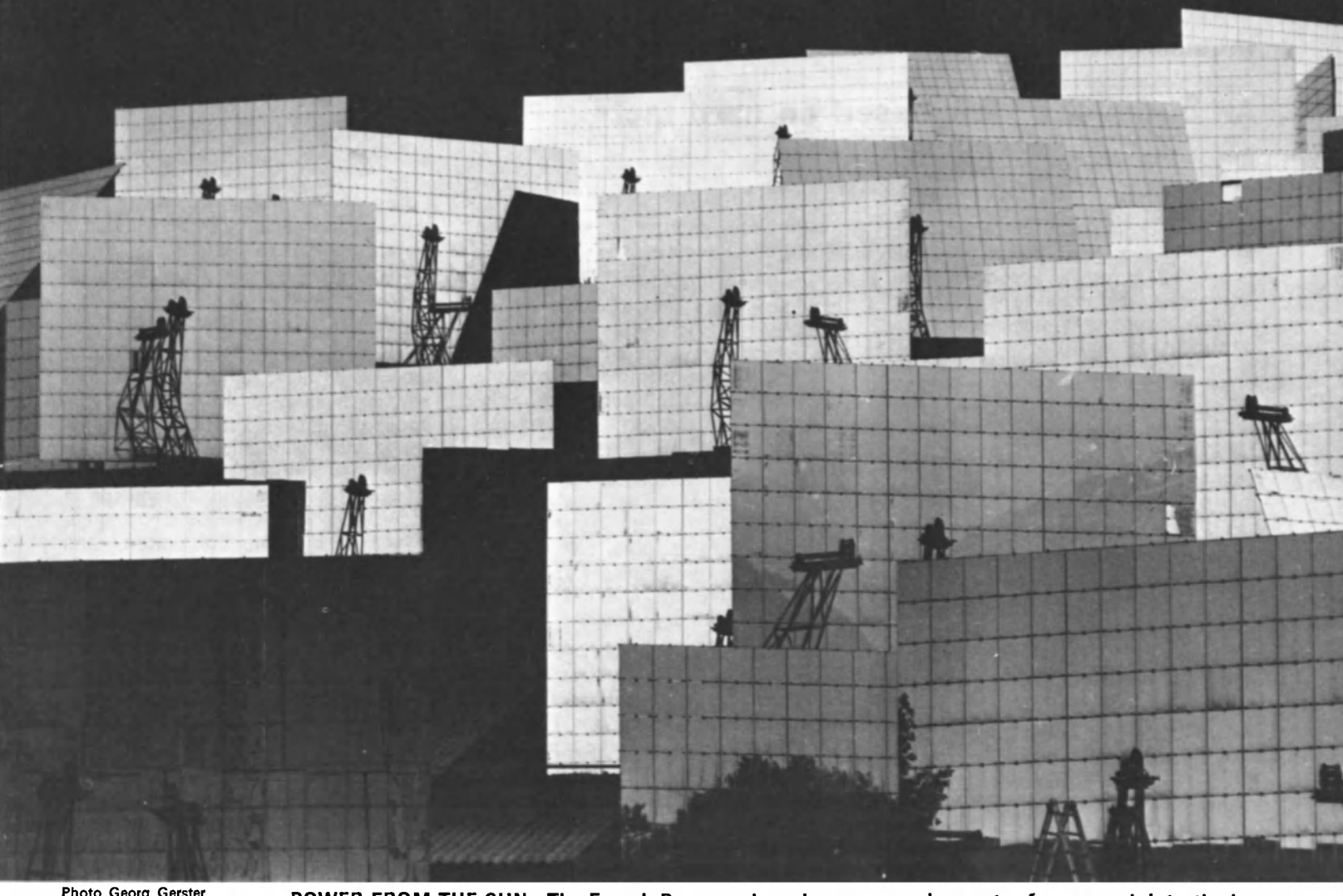

Photo Georg Gerster
© Rapho, Paris

POWER FROM THE SUN. The French Pyrenees have become a major centre for research into the industrial uses of solar energy. At the Mont-Louis solar laboratory, a sun-powered furnace has been used for specialized metallurgical research during the past 20 years (see "Unesco Courier", Sept. 1958). Today, the first solar "factory" is operating at Odeillo, six miles away. Here, some of the 63 mobile mirrors of its solar furnace capture the sun's rays which another concave mirror as high as a 9-storey building (not shown here) concentrates on to the furnace itself. "Increasing the world's green plant cover (which absorbs and uses solar energy)," says Nikolai Timofeyev-Ressovsky, "would trap enough energy to raise the productivity of the biosphere 2 to 3 times."

The biosphere is 10 times richer than we think

by Nikolai Timofeyev-Ressovsky

DURING the past twenty years the problem of the population explosion has moved to the centre of world-wide attention and concern.

Some economists believe that even with good infrastructural organization our planet is not capable of feeding (on the basis of current scientific and technical possibilities) more than 8 to 12,000 million people.

Consequently within the next hundred years or so nearly half the Earth's population would lack not only food but also the biochemical substances so important to modern life.

Over fifty years ago the great Russian naturalist Vladimir Vernadsky declared that the industry and technology of modern man make such a powerful impact on the earth's

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NIKOLAI TIMOFEYEV-RESSOVSKY *is a distinguished Soviet biologist and geneticist who has published ten major studies and over 300 papers on zoology, biophysics, radiobiology, genetics and ornithology. The winner of many scientific awards he is internationally famous as a member of many scientific associations outside and in the U.S.S.R.*

An optimistic view based on hard facts

surface that they may be regarded as a "new geological factor". Rapid population growth is accompanied by an equally rapid increase in the scale, volume and intensity of man's technical and industrial activities.

At this pace it is not inconceivable that life on our planet and the equilibrium of the biosphere will ultimately be disrupted, with disastrous consequences that might even jeopardize man's very existence.

At first sight, therefore, the possibility of achieving a balance between a teeming population and the limited productive forces of nature does not seem very encouraging. It is predicted that in a hundred years or so a good 50 per cent of the population will be "surplus", with no food to eat and perhaps not enough air to breathe and that water will be lacking for both domestic use and industry.

It follows that of the major scientific and technical problems before us, the balance between man and the biosphere must be regarded as the most urgent, and its global solution will need the participation of all branches of science, including mathematics.

But let us look at the same question from a more optimistic angle, using arguments that are not in the least utopian but are based on forecasts that can be made here and now in the light of current knowledge and achievements.

EARTH is a planet on which many varied forms of life have developed. All cosmogonic theories recognize the existence in the Universe of "dead planets", devoid of life. The great peculiarity which makes earth a "living" planet is its characteristic envelope known as the biosphere.

A rough outline of the working of the biosphere shows, first, an intake of energy from the sun. Within the biomass vast metabolic reactions take place as a result of which certain organisms are born, others die, some feed on others, make use of their products, and so on.

It is an immense continuous biological cycle with countless materials and energy forms changing from one biological state to another. The cycle also has an outlet at the point at which a certain amount of living matter and energy is lost in the formation of sedimentary rock.

What new resources can this vast biological cycle offer to man? Let us consider this question on three levels: the energy intake; the biological cycle; the end of the biological cycle and the beginning of the geological cycle.

First, the earth receives a certain amount of solar energy. Of this only the fraction absorbed by plants capable of photosynthesis is of biological interest. Of the total energy received only 1 to 10 per cent, varying according to geographical region, is absorbed by plants and not all of it is used for photosynthesis.

We can speak of an "efficiency coefficient" in Nature just as we can in technology. This coefficient is difficult to compute exactly but it can be said to vary between 2 and 8 per cent, depending on the species of plants.

Thus we see that even at the "intake" point man can do something to make plants absorb a greater amount of energy—by simply increasing the density of the earth's green cover.

We have to admit that so far he has done the contrary. In his economic and industrial activities man reduces this density by over-exploiting forests, pastures and fields. Green cover density is also lower than it need be because very little is done to reafforestate deserts and reclaim arid lands.

But it is quite certain that in the present state of technology and industry it is perfectly possible in theory to reverse this process and to raise the density of the green cover on land and in suitable stretches of water, especially fresh water lakes.

It has been calculated that if this were done, the rate of absorption of solar energy would be increased at least 1½ to 2 times. Biological productivity would be substantially increased, probably 2 to 3 times. This is precisely the production increase required in the forecasts for the next hundred years.

Let us now consider the major biological cycle itself. Man cannot really be regarded as a thrifty manager of his natural resources, for he destroys or seriously jeopardizes the balance of plant life and wildlife. A study of the reproduction of land and water animals and plants should make it possible to increase the effective productivity of the vast biological cycle considerably, simply because a vaster area of the earth's green cover can sustain a greater number of animals.

In the last ten years genetics—the science of heredity—has discovered more and more about the structure and functioning of the genotype, the code of genetic information transmitted from generation to generation. Soon man will probably be able to influence these various phenomena in order to increase yields and accelerate selective breeding of crops and livestock, and this too can enormously raise the feedback of the biological cycle.

We may therefore say that at the level of the biological cycle man can obtain eventually two, three or even more times as many useful products as he does today. In Japan, for instance, over 20 species of algae (seaweeds) are already used in the manufacture of foods for human consumption and for animal fodder.

LET us see what increased potential all this gives us. At the point of energy intake the increase in the rate of absorption of solar energy and plant efficiency gives us a productivity increase of from 1 to 2, and at the level of the major biological cycle we have a further increase of 3 to 4, which gives a total increase of about 6 to 8 times. And this is possible solely on the basis of established knowledge and current techniques.

Let us now look at another equally important biological problem. We know that all over the earth there are more or less complex biological communities consisting of numerous species or organisms living together. So far we do not know by what mechanisms such communities persist through time—provided that man does not disrupt their equilibrium or modify the species coexisting in them.

When man has found the key to the balance of nature, he will be able to obtain infinitely more from the biological cycle than he does now. He will be able to alter and improve the earth's biological communities at will, deliberately, scientifically and to his advantage. And if this enables him to raise the biological productivity of the earth a further 1½ times, that will bring the total increase up to ten times.

Now let us look at our last point—the "outlet" of the biosphere. We know that in some parts of the earth, at the bottom of some lakes, the mud, due to a mineralization process by living organisms, turns into soluble salts and is ultimately transformed into "sapropel", an extremely interesting organic substance mainly composed of carbohydrates, proteins and fats.

There are already many uses for this substance. The Japanese employ the best quality in foodstuffs, the medium qualities in animal feed and the lowest as organic fertilizer. In other countries it is used in sweet-making as a substitute for gelatine and agar. But by and large it is still used only in very small proportions.

This brings us to a far wider issue. It is certain that in future it will be the special task of biotechnical engineers to study the products of the biological cycle with a view to preventing the gradual degradation of valuable substances into a conglomerate of lower molecules of little utility, inorganic salts and limestone.

These specialists will try to harness the products of the biosphere at the point where they are present in their most valuable forms—organic macromolecules of carbohydrates, proteins and fats, which mankind needs so much. This is the third level at which man can increase the natural productivity of the planet.

I began with a rather pessimistic account of the rapidly widening gap between population growth and the natural biological reserves of our planet. But after examining the processes going on in the biosphere and what we have learned from the research of leading scientists we can make a far more optimistic forecast: Man can increase the earth's productivity not twice but ten times and more without damaging the potential capacity of the biosphere.

The conclusion is obvious. The most important and most urgent problem is that man should learn to use the products of the biosphere rationally and with moderation. Scientists must start now to find a solution.

A first step would be to make an exhaustive inventory of the environment. Action must be taken immediately to safeguard nature and to develop the new technology which will eliminate from every branch of industry all sources of pollution and contamination of the biosphere.

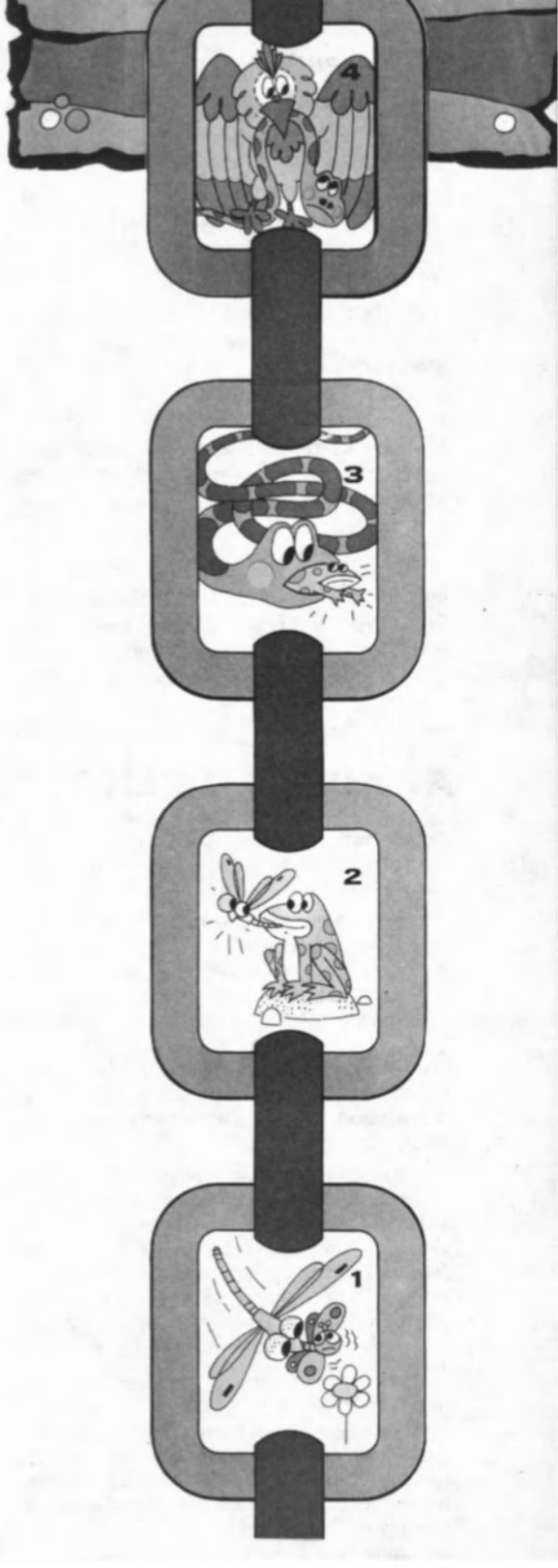
Methods used in forestry and fishing, etc. need to be rationalized at once; greater use should be made of new species of living organisms; the density of plant cover must be rapidly increased; biological productivity of the various sectors of the biosphere must be raised.

All these inter-related tasks can be carried out only if we co-ordinate the efforts of many fields of science and draw widely on the most modern materials and the most varied industries. And we should never forget that the No.1 problem facing mankind today has got to be solved. For mankind it is a matter of life or death.

OVER the past 15 to 20 years, the Soviet Government has shown that the protection of nature is one of its main preoccupations. Among other legal and practical measures, it has launched vast reafforestation schemes, made studies of the hydrological balance of northern waterways, of the Caspian and Aral Seas, taken steps to preserve Lake Baikal from pollution and introduced laws concerning soil use and pollution of air and water, to quote but a few examples.

Such action was reinforced and extended by the adoption, in September 1972, by the U.S.S.R. Supreme Soviet, of a new series of far-reaching measures concerning protection of the environment and the rational use of natural resources.

In spite of the effectiveness of these measures and of those adopted in other countries, they are not in themselves enough to resolve many of the problems of the pollution of the atmosphere and the oceans. International co-operation is essential since pollution entails world-wide consequences which can only be controlled by the concerted efforts of all countries. ■



S.O.S. FOR PLANET EARTH

Classroom studies and children's books are bringing home the problems of the environment to young people in many countries. In Italy the International Book Centre and the Giunti-Bemporad Marzocco publishing house, in Florence, recently brought out an imaginative children's book, "S.O.S. for Planet Earth" by A. Pacini and G. Masini. Subtitled "An Ecological Message to all the World's Children", it features attractive pull-out and 3-dimensional illustrations, Left, Planet Earth imprisoned in a bottle marked poison. Above, pull-out showing, from bottom to top, part of Nature's food chain threatened by Man's abuses and negligence.

Photos © International Book Centre-Giunti-Bemporad Marzocco, Florence, 1971.

MEDITERRANEAN: DANGER! OIL POLLUTION

(Continued from page 17)

Exploration of the Mediterranean Sea (ICSEM, in Monaco), the FAO Working Party has commissioned an updated study on the state of pollution in the Mediterranean.

A draft agreement between all Mediterranean countries has been hammered out during a series of meetings in Malta, promoted by a non-governmental organization called "Pacem in Maribus", the members of which are scientists, lawyers and politicians from all over the world interested in marine problems.

There have also been important bilateral and multilateral discussions. Parliamentary groups from the countries of the northern Mediterranean basin, including Italy, France, Yugoslavia and Monaco, have frequently discussed the serious problems of the Adriatic and Tyrrhenian Seas.

These direct contacts between countries on the shores of the Mediterranean are in line with the proposals of the United Nations Conference on the Human Environment in Stockholm, which has recommended, in an effort to eliminate all voluntary sources of oil pollution by 1975, that regional agreements should be concluded for the protection of specific sea areas. But an agreement between all Mediterranean countries would be of only relative value unless it were also honoured by all countries (including those outside the Mediterranean) whose tankers use its waters.

For this reason the problem needs to be tackled in the amendments to be made to the 1969 London Convention and which are to be signed in 1973 by IMCO's member countries.

Italy and France have proposed the inclusion in the 1973 Convention of a section concerning the Mediterranean and other "special areas". This would specify what anti-pollution measures should be taken and would make compulsory the installation and use of plants for treating tanker ballast.

The building of such plants at all terminals where crude oil is loaded would be an immediate and practical solution, since the Mediterranean can no longer wait for long-term solutions and the theoretical prospects of new technologies to mature. ■

Carlo Munns

A WORLD POLICY FOR THE ENVIRONMENT

(Continued from page 6)

recommended that the environment secretariat should be located in Nairobi (Kenya).

Innovations now undertaken at national and international levels should, within a few years, give us some practical evidence of how best to structurally organize and integrate developmental and environmental goals and operational programme. To obtain an input of information, properly balanced in relation to programme needs, presents an additional challenge.

Availability of information in a usable form is a necessary, but insufficient, step toward better environmental decisions. There is also need to insure that a broad spectrum of decision-makers are aware of the availability of the data, and that they correctly appraise its significance for their work.

Both the Biosphere Conference and the U.N. Stockholm Conference recommended education and training programmes for technical, professional, and administrative personnel to enable them more effectively to integrate ecological concepts into their work. And, because many environmental decisions require a scientific input, it has been necessary to improve the ability of scientists to advise and to assist public officials in arriving at ecologically valid environmental and developmental decisions.

Prior to the Stockholm Conference, the International Council of Scientific Unions' Scientific Committee on Problems of the Environment brought together, at Canberra (Australia), a group of scientists from developing countries for the purpose of clarifying environmental issues, especially in relation to development objectives.

Regional seminars for officials, chiefly from developing countries, were sponsored by the United Nations Economic Commissions and the Regional Office in Beirut; and the Secretary-General of the United Nations Conference on the Human Environment convened a panel of experts in June 1971 at Founex (Switzerland) to consider the interrelationships of development and environment, with emphasis on policy formulation and action.

These efforts are among the more important of a much larger number of official and unofficial conferences, seminars, and workshops intended ultimately to improve the quality of environmental decision-making. Pre-Stockholm efforts in this direction were necessarily experimental; post-Stockholm training for environmental decision-making will almost certainly become a regular and continuing function of many public agencies and scientific and commercial organizations.

The purpose of decision-making is to arrive at a judgment regarding proposed action: whether, how, or when to act. A decision against action may be as significant as one for action, and the *way* in which a decision is made may be as important as the substance of what is decided.

AT international levels, the diversities among nations require a broad base of deliberation for decisions that affect all or large groups of national states. At national levels (but increasingly at international levels also) there is need to benefit from the contributions of the non-governmental organizations to the decision process. Non-governmental organizations were strongly represented at the Stockholm Conference and made major direct and indirect contributions to official action.

A structure for environmental decision-making is thus emerging, slowly perhaps in relation to need—but rapidly by historical precedent. This structure may in time provide a coherent system for environmental decision-making that links all political levels—local, national, regional, and international, and that provides regular channels for continuous communication among scientists, planners, and decision-makers, as well as between official and non-governmental agencies. But meanwhile, who makes the decisions on environmental affairs?

A superficial answer would be: almost everybody—or in some instances, nobody. The present disorders of our global environment reflect the inadequacy of our decision process at all jurisdictional levels. No nation as yet can claim true expertise in environmental management. The so-called developed nations are only a few years ahead of the developing states in awareness and experience.

Environmental protection technologies may be rapidly transferred where receptive conditions exist. Awareness of the need for wise environmental management is rapidly becoming evident among the leadership in many developing countries. Ecologically sound policies are increasingly understood to go hand in hand with effective development. There is indeed ground for optimism that, at least, some developing countries may bring their environmental problems under control more rapidly than will the older industrialized states.

The task of international environmental and developmental policy today is to develop the concepts, criteria, and institutional arrangements which will give the best chances for public action addressed to the broad range of human needs experienced by all mankind. ■

Lynton K. Caldwell

UNESCO NEWSROOM

Unesco General Conference

Unesco has now embarked on the world programme for 1973-74 in science, education and culture adopted by its General Conference in Paris on November 21. The conference, at which the People's Republic of China was represented for the first time, approved a budget of $119,954,000 for the Unesco programme. Admission of Bangladesh and the German Democratic Republic during the conference brings Unesco's membership to 131.

Nature conservation project

A project to distribute to schoolchildren booklets on nature conservation written and illustrated by educators and artists in Kenya, India and Venezuela is being launched by the International Union for Conservation of Nature and Natural Resources in collaboration with Unesco. A Unesco Gift Coupon Project* will pay for the design and printing of the booklets.

** Project No. 528. For further information on Unesco Gift Coupons—a form of international money order which beneficiaries in developing countries can use to buy school supplies and others materials—write to: Unesco Gift Coupon Programme, Place de Fontenoy, Paris-7e.*

International science prizes

Two international science prizes were presented by Mr. René Maheu, Unesco's Director-General, at Unesco H.Q. in Paris on November 22. The Unesco Science Prize for achievements of special value to the developing countries was awarded jointly to Dr. Viktor Kovda, the distinguished Soviet soil scientist and to a group of nine Austrian scientists who developed a new and cheaper way to make steel. The Kalinga Prize for the Popularization of Science was awarded to the internationally-known French physicist, Prof. Pierre Auger. Prof. Auger has written and broadcast regularly for the public, and helped to bring science into the programmes of the French Radio and Television Service.

Jawaharlal Nehru fellowship for Indian graphic artist

The young Indian graphic artist Narendra (Narendra Nath Srivastava) has been awarded the Jawaharlal Nehru Memorial Foundation Fellowship for his work in the development of Devanagari script used for writing Hindi and Sanskrit. In our December 1972 issue on the Art of the Book, we published a work by Narendra (not Navendra, as misprinted in the caption on page 35) entirely composed of his newly-designed Devanagari characters. An exhibition of paintings by Narendra was held in Paris last month.

Photo Dominique Roger, Unesco

To save Venice

A series of four gold and silver medallions have been issued by the "Venezia Nostra" Foundation (Italy), as part of Unesco's international campaign to save Venice. Funds from their sale, which closed on December 31, 1972, will be used to restore the famous Rialto bridge. The reverse side of the medallions are an exact replica of a 16th century Venetian sequin, an ancient gold coin.

Dr. Hans Rieben

The "Unesco Courier" regrets to announce the death, in Berne on November 23, 1972, of Dr. Hans Rieben, managing editor of our German language edition since it began publication in 1960.

FURTHER READING ON THE ENVIRONMENT

Planet in Peril
by R.F. Dasmann. Co-edition Unesco-World Publishing, New York, 1972, $8.95; Unesco-Penguin Books Ltd., London, 1972, paperback 30p, 4 F, $1.25 (Canada) (see inside back cover).

The Problems of the Arid Zone
Proceedings of the Paris symposium, Unesco, 1962, £3.85.

Use and Conservation of the Biosphere
Views and findings of scientists at the first world conference on Man and the Biosphere, at Unesco, Paris, 1968. Unesco, 1970, £1.80, $6.

In Partnership with Nature
by Daniel Behrman. Unesco, Paris, 1972.

Development and Environment
Report and working papers of a panel of experts convened by the Secretary-General of the United Nations Conference on the Human Environment, Founex, Switzerland. Mouton, Paris, The Hague, 1972.

The Limits to Growth
A report for the Club of Rome's project on the predicament of mankind, by Dennis and Donella Meadows, Jorgen Randers and William Behrens. Universe Books, New York, 1972. $2.75.

Only One Earth
by Barbara Ward and René Dubos. André Deutsch, London, 1972, £2.95; Penguin Books Ltd., 1972, paperback 45p.

The Geography of Hunger
by Josué de Castro. Little Brown, Boston (U.S.A.) Gollancz, London, 1952.

Of Men and Crabs
by Josué de Castro. Vanguard Press, New York, 1970.

The Challenge of World Poverty
by Gunnar Myrdal. Pantheon Books, New York, 1970.

Asian Drama
An Inquiry into the Poverty of Nations, *by Gunnar Myrdal.* Abridgement by *Seth S. King.* Pantheon Books, New York, 1972.

The Careless Technology
Ecology and International Development, edited *by M. Taghi Farvar and John P. Milton.* The Natural History Press, New York, 1972, $25.

The Community of Living Things: In the Desert (A. and E. Klots), **In Field and Meadow** (E. Schneider Ress, ed.), **In Forest and Woodland** (S. Collins), **In Fresh and Salt Water** (B.B. Cadbury), **In Parks and Gardens** (R.S. Lemmon). All volumes published in co-operation with the National Audubon Society, N.Y. by Creative Educational Society, Inc., Mankato, Minn. (U.S.A.), 1967, $5.95 each.

Resources and Man
A study and recommendations by the Committee on Resources and Man, National Academy of Sciences. W.H. Freeman and Company, San Francisco, 1969, clothbound $5.95, paper, $2.95.

Population, Resources, Environment
by Paul R. Ehrlich and Anne H. Ehrlich. W.H. Freeman and Company, San Francisco, 2nd ed. 1972.

World Eco-Crisis: International Organizations in Response
by David A. Kay and Eugene B. Skolnikoff. University of Wisconsin Press, U.S.A., 1972.

Biosphere: A Study of Life
by N.M. Jessop. Prentice-Hall Inc., New Jersey, U.S.A., 1970.

Teaching for Survival
A Handbook for Environmental Education, *by Mark Terry.* Ballantine Books Inc., New York, 1971.

Man in the Living Environment
A Report on Global Ecological Problems. Published for the Institute of Ecology by The University of Wisconsin Press, 1972.

Basic Issues in Environment
by Ira J. Winn. Charles E. Merrill Publishing Co., Columbus, Ohio, 1972.

Political Economy of Environment
Problems of Method. Co-edition Ecole Pratique des Hautes Etudes, Paris, and Mouton, Paris and The Hague, 1972, 34 F.

The Closing Circle
by Barry Commoner. Jonathan Cape Ltd., London, 1972.

Letters to the Editor

THE EMERGENCE OF MAN

Sir,

This letter is sent to you by a group of school mothers with children in a private school at Berne (Switzerland). We meet every Monday afternoon for cultural group work. Several members of our group are subscribers to your magazine and we have used many of your interesting and well compiled issues in our discussions.

Our discussions roam into many fields, e.g. education, religion, philosophy, etc., but our main theme might be summed up as "Man, as a physical, soulful and spiritual Being, his origin, development and future within the present, highly materialistic and technical world."

Our letter is brought up by your August-September 1972 issue, "The Emergence of Man". This question is of paramount importance to us and a reply is a human necessity, not only of passing scientific interest. We were deeply disappointed by the *contents* of this issue. Such a criticism does not apply to the *make-up* of the magazine.

The problem of the origin of Man concerns every individual on earth. The reply shapes his attitude towards life and fellow-beings. It therefore hardly seems proper to base a reply quite narrow-mindedly on only one scientific hypothesis. The question of origin and descent of Man has been raised ever since he appeared on earth and a wide range of answers were given. In your issue, the reply is based on one theory, formulated only a short time ago and transformed several times since its conception.

Evolution is a factor not to be neglected in a reply to the question about the origin of Man. One version follows Darwin and Haeckel through a long line of anthropomorphous apes to Man. Another version, as taught by one branch of modern evolutionary research, remains within the field of materialistic matter and reduces everything: life, perception, spiritual activity to variable chemical processes. The difference between these versions is only one of degree, but at least both should have been covered.

Since the first unquestionable and established traces of Man, which your issue shows in his artistic endeavour (tools, ornaments, rock carvings and paintings, etc.), he has asked himself this question during thousands of years. His questions resulted in many different replies, but this basic experience of mankind is not even mentioned in your issue.

Since remote antiquity, Man felt himself to be a creation, if not even a part of higher powers. Of importance to him were those influences which turned him into a feeling, aspiring, responsible being. He over-emphasized this part of his entity, to the exclusion of other parts, so that in time the necessity arose for him to become conscious as well of the origin of his physical body.

Your magazine is published in many languages and it reaches almost all countries of the world. In the hand of a teacher it turns into a tool for shaping future generations. The danger is greatest in the underdeveloped countries, with the almost complete absence of sufficient teaching aids and books, that such pictures are accepted at face value and without any doubts. This also applies to the text, insofar as this can be easily read or translated. Generations, striving towards a new and overall view of the world, get this one-sided Darwinian version of the "struggle for survival" and "natural selection" drummed into their brains as proof of their descent from the apes!

We feel that you are fully aware of the tremendous responsibility involved in your work. Unfortunately, it seems to have escaped your awareness how destructive such a biased reply must become in the minds of people, where untold preceding generations knew themselves to be in contact with a spiritual reality, or where such a relation was being sought for. Your reply tears them away from such relations. Man is thrown back exclusively to his purely physical organism, and is linked into a evolutionary chain created by chance and uncontrolled mutations.

Any thinking person can accept "Creation and Evolution", or "Creation with Evolution", if both are being directed towards a pre-planned goal under the guidance of some higher wisdom. The chance product of unplanned biological and chemical reactions and mutations cannot be held responsible for any results of his actions, even if he destroys himself and others in the clutches of drugs, drinks or passions. Not one problem of human society or of mankind can be solved by ignoring the human-spiritual components of Man. Unesco, a champion for the dignity and the rights of mankind, cannot be allowed to feel content with the concept of Man as a purely physical being alone and with the belief, that the human race is exclusively the product of freak mutations within biological and chemical processes.

A materialistic belief, as it was still proclaimed by Kautsky, may not be considered as up-to-date and binding in our days. The overcoming of materialism should have progressed beyond the stage requested by Driesch and others. The "Unesco Courier" owes it to its readers to inform them of the latest developments in research and the results obtained thereby.

In a question as important as the one about the origin of Man, the viewpoint of modern scientists, to mention only Einstein, Oppenheimer and Heisenberg is a decisive factor in a renewed humanism.

From many of your former issues we have formed the opinion that your organization, more than others, looks upon Man as a free and morally responsible being. If this is correct, the biased theory of the origin of Man, applying to the human body only, cannot suffice in itself. In the records of great religions and nations, as well as in modern spiritual research, may be found a host of references to and proofs for the physical-soulful-spiritual origin of mankind.

Therefore, we hope that a future issue might try to probe a bit deeper for a reply to the question: "Where are the origins of Man as an *entity?*"

Dr. J. Hildesheimer
Spiegel bei Bern, Switzerland

This letter was signed by 31 members of the Bernese Monday Group of school mothers and by about 280 other persons who support the views in the letter —Editor.

THE GREAT HERITAGE OF IRAN

Sir,

I have read with great interest your article in the July 1972 issue of the "Unesco Courier" entitled "Renaissance of Arab Thought and Literature".

It is indeed, fascinating to note the important scientific and cultural impact of Islamic civilization on the history of mankind.

There is, however, a point of historical clarification, well known to professionals in the field, which may not be evident to all of your readers. At the height of its glory, the broad Islamic empire, was the melting pot of many different races, languages and cultures. During this golden age, the rich and powerful arabic language became the major source of universal scientific and literary communication. The treasures of this intellectual and philosophical heritage had emanated from many different nations and races, which eventually coalesced into the great family of Islam. It may, therefore, be appropriate to pay due tribute to the great scientists, philosophers and writers of Islam, not only as the torch-bearers of Islam, but also as the heirs of those nations which composed the Islamic empire.

Many of the great writers mentioned in your article, such as Ibn al-Muqaffa, Ibn-Sina (Avicenna), Al-Khwarazmi, Al-Biruni, Ar-Razi and Al-Farabi, were of Iranian origin. They wrote in their mother tongue (Persian), and made numerous long-lasting scientific contributions in Arabic, that rich language of Islam.

In our day, many scientists of all nations, choose to write for instance, in English. Evidently, the choice of a common means of communication does not reflect on one's national origin.

The above note is brought to the attention of your readers in the interest of historical accuracy. Looking, however, from a higher plateau, beyond all national boundaries, great men belong to all mankind.

Prof. F. Reza
Ambassador, Permanent Delegate
of Iran at Unesco

The article in our July 1972 issue dealt with Arab and Islamic thought as a world phenomenon irrespective of the national origins of the various scientists and scholars mentioned. Only a few months earlier a special issue was entirely devoted to "Iran, Cultural Crossroads for 2,500 Years" (Oct. 1971) where the contributions of all the scientists mentioned by Ambassador Reza were described in detail—Editor.

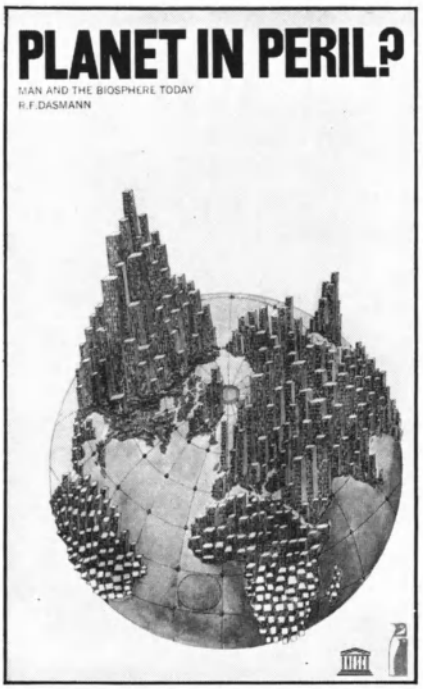
Imp. GEORGES LANG, PARIS. — Dépôt légal C 1 — Décembre 72 — IMPRIMÉ EN FRANCE (*Printed in France*)

A Unesco guide to man and the biosphere

■ A basic guide for the ordinary reader to the problems of the environmental crisis, written for Unesco by Raymond F. Dasmann, Senior Ecologist at the International Union for the Conservation of Nature and Natural Resources.

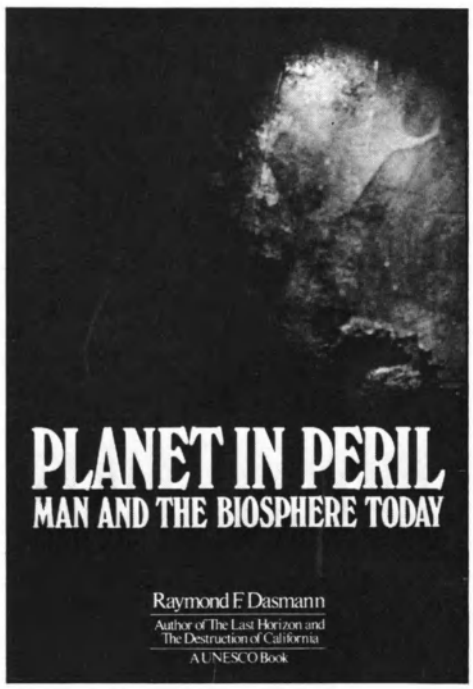
■ Explains the complexities of the biosphere—the thin layer of air, water and land on our planet where life exists—and man's increasing impact on it in terms that everyone will grasp.

■ Essential reading for everyone who wants to understand the global problems of safeguarding and improving the quality of life.



U.K. EDITION. Paperback

Co-edition Penguin Books-Unesco. Exclusive distributor in U.K.:Penguin Books Ltd., 1972. 135 pages, illustrated. 30 pence, 4F, $1.25 (Canada). Not for sale in U.S. or Philippines.



U.S. EDITION. Clothbound

Co-edition World Publishing-Unesco. Distributor in U.S. and Philippines: World Publishing, New York, 1972. 242 pages, ill. $8.95 (U.S.). Not for sale in U.K.

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Animal shadowland

The ancient and almost forgotten art of the outline, commonly —and erroneously—called the "silhouette" has been brought to a flowering which it has perhaps rarely known before by an American artist born in Florence, Italy, Ugo Mochi. His designs are not only works of supreme beauty but also detailed and scientifically accurate studies of wildlife, birds, animals and nature. Two examples are shown above. See also centre pages. Photos © The American Museum of Natural History, New York